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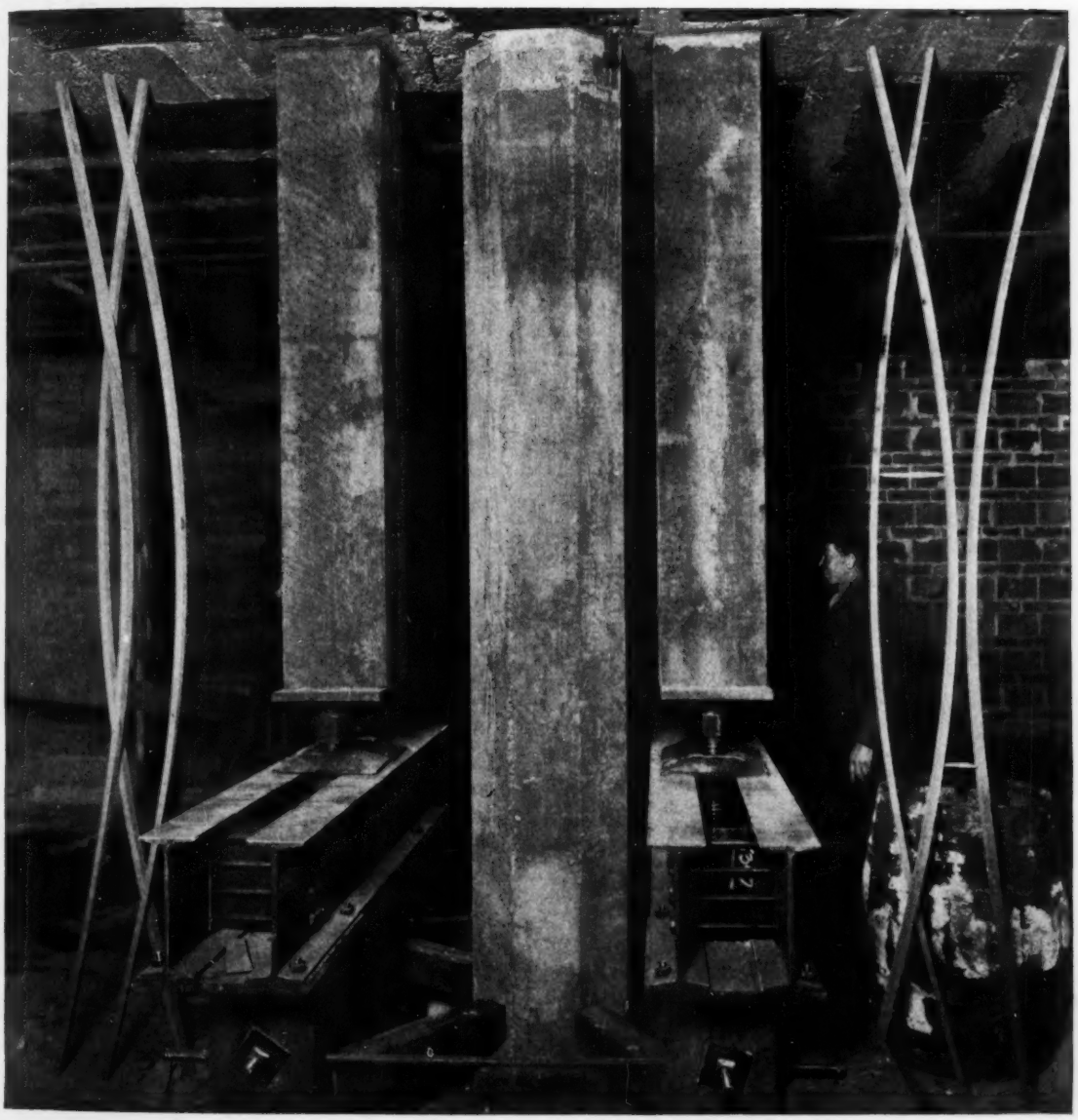

Shoring in Seattle Building During Repair of Columns

Prompt Column Repair Prevents Building Collapse

Notes on Western Reclamation, II
A Staff Review

Santa Fe Freight Terminal and Warehouse at Dallas

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FRANK C. WIGHT
Editor

Volume 93 NEW YORK, DECEMBER 11, 1924 Number 24

Economy or Parsimony

PRESIDENT COOLIDGE'S message to the short session of Congress has all the generality of a party platform, except in the fiscal section where the President has indulged his passion for economy, fortified, doubtless, by the success of his emphasis on that program in the recent election. No one can criticise such a program if sanely conducted, but the wording of the message leads one to wonder whether the Coolidge heredity may not be so strong that he confuses parsimony with economy. True economy is something more than merely not spending. Government must continue and, like a business, in continuing it must grow. To provide for that growth by gradual expenditures is cheaper in the long run than to let facilities become outworn to the point of replacal or to neglect to provide new facilities that will increase efficiency. Mr. Coolidge himself voices this sentiment in his message, but unless his behavior belies his character his tendency will be to condemn necessary expenditure in his zeal to prevent that which is unnecessary. The public may take consolation, however, in the possibility that executive parsimony may act as just the proper check to Congressional lavishness, and in the end a balance of somewhere near the desired expenditure may be reached.

When To Spend

IN HIS plea for economy the President emphasized one thing of importance to public works officials; that is, the growing expenditure by the governments below the federal. State, county, district and city indebtedness, he said, is increasing at the rate of a billion a year, while federal indebtedness is decreasing. The comparison is not quite fair, for the national debt is made up largely of war bonds, issued for something now past and when paid off they cease to exist. Public works on the other hand, are continuing necessities and when an issue to pay for one is paid off, another is required to take its place. The city, county and state acquire practically all of their indebtedness to build public works; the federal government acquires a major part of its debt in the interest of public defense and in the intervals between wars that debt must decrease. But leaving that aside, the President does well to comment on the rising cost of government and to suggest for the minor subdivisions that same economy he recommends for the federal government. But here again, the individual directors of expenditure, scattered throughout the many communities of the country, must put to themselves the question of present necessity against future needs. We must have schools, we must have roads, we must have municipal conveniences and services, and the standard of living of our people will decrease in the proportion that we do not increase and replace them. Each appropriating official must decide future expenditure equally as much in the light of this social demand as in the light of the cry against increased taxation.

Tax Exemption and Government Spending

THE question of public expenditure is never discussed nowadays without an immediate damnation of the tax-exempt provision on government bond issues. Some very loose talking is being done in the advocacy of a repeal of tax-exempt privileges to our minor governmental agencies. Not only is it claimed that all capital is rapidly running to these government issues, to the distress of private industrial ventures, but the rapidly growing tax burden is also blamed on what is claimed to be the easy sale of any kind of government bond. It is probably true that a great amount of tax evasion, among the wealthy, may be laid to the purchase of tax-exempt bonds, but it is by no means proved that the increase of government expenditure is due to the same cause. Certainly, it has never been shown that any great number of communities have rushed into construction because of the ease with which their bonds can be sold, although that is a common assumption. It would be interesting to know, not how many rich men have bought tax-exempt bonds (which is roughly measured by the reduction in the returns from the high income brackets) but how big a percentage of these tax exempts have been bought by this class and how much by those whose income tax would be only slightly affected but who are looking for safety first and income afterward. Until such figures are available we may assume that the increase in government spending is rooted in something deeper than exempt taxation.

A Change in Viewpoint

COMPARISON of the accommodations for traffic between the 35-year-old Burnside bridge across the Willamette at Portland, Oregon, and the one now being built to replace it shows strikingly how the viewpoint of the bridge planner as to traffic accommodation has changed in the past thirty years. As the old bridge was built to replace ferries there had been no previous experience with the need of continuous traffic across the river nor was it the custom at that time to give much consideration to future traffic needs. As a result the inadequate capacity of the old bridge has for years hampered intercourse between sections of the city on opposite sides of this river. At the time when the old bridge was built and particularly among the more elderly "city fathers," it is reported that this bridge—or any bridge across the Willamette—was looked upon as more or less of a luxury and an extravagance. The Portland *Oregonian*, commenting editorially on the time when this bridge was built, refers to it as "a period of scant vision and grudging expenditure" and goes on to say that companies formed for the promotion of other bridges did not succeed because "public inertia frustrated progress." In modern times the designer takes a broader viewpoint; he wants to know not only the present needs but probable rate of traffic growth in future years and he balances the interest on a higher

cost now against costs of various sorts entailed in securing the greater capacity that may be needed twenty to forty years hence. Not only is the modern demand for improvements vigorous and insistent but the public is becoming educated to look ahead and to build for the future.

Praise for the Gang Boss

COMBINATION equipment is so familiar a sight in these days of a multitude of machines for construction that its mention as a curiosity arouses derision. One no longer gives a second glance at our old friend steam shovel rigged out to appear also as a crane, a dragline, a clamshell and a pile driver. Almost, the equipment makers have left no further opportunity for the ingenious gang boss to torture some new service out of his special purpose machines. But not quite. Last winter a contractor who had an idle concrete blower and pipe line desired to shift a pile of broken stone a few hundred feet across his storage yard. He set up the concrete blower and blew the stone to where he wanted it. In another place another contractor having a large volume of heavy paints to mix, cleaned out one of his concrete mixers and did an excellent job of paint mixing. There are other examples which might be paraded, but these two make the points striven after. The keen and resourceful job foreman is no less a power in construction now that there are many machines than he was when there were few and the most of them home made. If one lacks conviction let him go into one of New York City's subway construction operations and watch the infinity of ways worked out to meet the underground conditions which arise. Here the gang boss nails individualism high above standardization in construction.

Highway Research

IF PRESENT multiplication of highway engineering and highway transport associations has any reasonable justification it lies in the fact that each has a definite function and confines itself to that function. Engineers are invited by one association and another to give, between November 15 and February 15, about 30 days time to convention work. They may rightly demand, therefore, that the subjects they are to consider and discuss shall not be duplicated. Even more certainly they have the right to ask that entirely foreign questions shall not be introduced in the proceedings of highly specialized conference bodies, as was done last week at the meeting in Washington of the Highway Research Board of the National Research Council. Research, like charity, is a term which "covers a multitude of sins" but it certainly does not include a violent condemnation of surety bonding practice or the description of a patented joint placing device. Without hypercriticism one can object to at least half a dozen of the titled papers and discussions as foreign to the strict purpose of highway research. The objection is not that the subjects are unimportant or were not well presented. The contrary was true in both respects. They were merely interlopers. Their place was at the convention of the Association of State Highway Officials or that of the American Road Builders Association. As interlopers they curtailed the time and attention needed to consider the special research committee reports. These were important and deserved full presentation, particularly as they were not printed in advance, and they required general discussion, and did not receive it. There is enormous power for usefulness in the Highway Research Board. It is the only agency among highway associations for advancing and directing research in highway engineering and an important agency in highway transport research. It has developed finely and found its work. Let it not be interrupted by doing odd jobs for the neighbors.

Future Traffic Forecasting

ANY general rule for forecasting future highway traffic is discredited in the recent report of the committee on traffic analysis of the Highway Research Board of the National Research Council. Broadly, the committee reaches two conclusions on this subject. The first is that future traffic on a given highway is dependent on so many local conditions that it is impracticable to determine a forecasting factor based on motor vehicle registration which would be anything but misleading. The second is that it is useless to endeavor at the present time further to consider the determination of a factor for forecasting the saturation point in the utilization of motor vehicles in any community except congested urban districts. There will be very considerable disagreement with both of these conclusions. It has been for too long a time a pet diversion of many to predict the point in time or number when all the motor vehicles are owned that can be owned for the problem to be abruptly abandoned as unsolvable. There are, too, a number of studies, as that of the committee on regional plan for New York City, which in the opinion of the engineers point definitely to a rule for determining both motor vehicle saturation and future traffic. These proofs should be presented for discussion.

Steel Columns Again

SOME years ago the engineering profession incurred a debt to the taxpaying public in connection with a costly series of tests of steel columns made for the American Society of Civil Engineers at public expense, whose results were not given as thorough study as their cost and importance demanded. Pressure of war work made it impossible to give the tests further attention at the time. They were taken up again during the past year, Prof. A. H. Basquin, of Northwestern University, having volunteered to make the study, with the aid of the Bureau of Standards. One aspect of the result of this restudy has now been published by him in a monograph issued by the Bureau of Standards. In spite of its somewhat unattractive title, "Tangent Modulus and the Strength of Steel Columns in Tests," it evidences an intense interest in the subject and a vast amount of patient study on the part of its author, which merit the general appreciation of the profession.

The restudy takes an unfamiliar form, but it seems to have sifted the test results thoroughly and obtained from them all the useful data that they contained. Under these circumstances the fact is noteworthy that the conclusions strongly confirm existing views of column strength and that they also point out the way to progress in the field of steel columns.

Engesser's theory of column action is utilized, in place of theories better known to American engineers, as the means of analyzing the test results. This theory, briefly stated, assumes that all columns fail by buckling, so that the Euler formula will express their strength

provided the modulus of elasticity used in that formula is not the initial straight-line value (Young's modulus) but the momentary value which characterizes the compressive action of the metal at the moment of failure of the column. This value is given by the tangent to a compressive stress-strain curve; hence the term "tangent modulus." A simple graphical construction permits of obtaining the column strength for any given length-ratio, when once a curve of tangent modulus plotted on unit stress has been drawn for the material of the column. The author draws such curves, derives the column strengths which should result, and compares these with the test results. The agreement is about as good as that between any column theory and any set of tests, but no better.

This is not surprising if the arbitrary assumptions of the Engesser theory are considered. One of these is that at the moment of failure the stress-strain relation is uniform across the section and along the length of the column (just as Young's modulus applies to every element of an Euler column), which quite obviously is not the case. Karman has made an effective attempt to remedy the faults of this assumption, but Prof. Basquin finds that Karman's theory does not fit the present test results any better than Engesser's, which makes it apparent that the latter is affected by other vitiating assumptions. In short, the test results as restudied furnish no reason for accepting the tangent modulus theory as an improvement on established habits of thought concerning column action

However, the results of the Engesser analysis are interesting in their bearing on the Rankine theory. The data obtained indicate that the variation of column strength with length-ratio is very much the same under the Engesser theory as under the Rankine theory, and that the test results agree with the one about as well as with the other. Since the Rankine and Engesser formulas follow decidedly different lines of approximation to the problem, it may be surmised that their agreement with the test results is a matter of happy accident rather than first intention, and that no great virtue resides in either one. The practical column has many peculiarities that are not amenable to formula. Probably we can not hope to do anything better with it than to fix empirical strength curves on the basis of test results.

This has long been the practical view in structural engineering, at least in this country. Engineers here have never thought it feasible to cover the whole range of column conditions by a single law or formula. They have preferred to apply separate methods of calculation to short blocks, to columns of ordinary length as used in normal structures, and to long or Euler columns. Basquin's analysis of the present column tests—inincluding also those made for the American Railway Enginering Association—brings out nothing to show that this view of the column subject is anywhere at fault. And it may be said also that other recent studies of column strength, some of which centered on very long and slender columns for airplane use, justify the same conclusion.

A number of individual matters of interest appear in Basquin's report. One of them is the author's suggestion that a column is strengthened by testing; unfortunately, proof testing does not seem to be a practicable expedient at the present time. Another is the curiously irregular "wandering" of the paths of column deflections when plotted on a polar diagram. This wandering suggests that extensive though slight redistribution of stress takes place within a column as its load is increased—another fact limiting the applicability of any theoretical definition of practical column action.

But much more important is the emphasis placed by the study in its entirety upon the vital dependence of column strength on quality of material. In this respect the author is in full agreement with the column committee of the American Society of Civil Engineers which reported on the tests some years ago. Variation of material, in short, is the principal unsatisfactory feature of steel columns today.

In one comparison made by the author, the columns of the entire series, though intended by the steel makers and fabricators to be of identical material, vary over a range represented by the figures 19,500 to 34,600, where ideally uniform material would have zero range. The figures quoted are not figures of column strength, nor is column strength directly proportional to them yet its variation will be almost as large. Since these were specially made test columns, it seems quite certain that in ordinary everyday columns an even greater range of variation may be expected. This condition is not particularly creditable to the steel maker; whatever progress the steel industry has made in the last two or three decades, it does not appear to have progressed in its ability to produce uniform and uniformly dependable column material.

Until ways are found to decrease the great variation in quality of material, we will not be in a position to use steel columns as efficiently as we should. Strong columns cannot be loaded as heavily as would otherwise be possible, because for all we know they may be weak columns. We cannot depend on the steelmaker to furnish us material that will make strong columns, and we appear to be unable to test the steel in such a way as to select the good columns and reject the bad ones.

The deficiency of our testing practice in this respect, in fact, has a direct bearing on the character of column test results. With this in mind the author makes a suggestion that should be worked out more fully in some research testing laboratory. The tension test is misleading, except in the minds of those who hold that *ipso facto* the compressive yield-point is the same as the tensile yield-point. But, says the author, a compressive buckling test of a small test specimen might give a real test of the desired quality figure. This agrees with an editorial suggestion we made some years ago. Prof. Basquin's finding that we need some such tests more than anything else in the field of steel columns supports our view in gratifying manner.

In summary, then, the present restudy of column tests warrants engineers in feeling satisfied with existing practice as to formulas of column strength, but not with the column strength itself or with test methods relating to columns. The engineer can obtain stronger columns if he will make the tangent modulus curve steeper and higher, in other words, if he will use harder steel; and he can reduce his margin of ignorance by reducing the great variation in compressive quality of column steel. He ought to find ways of eliminating the occasional low-yield steel, which produces weak columns, and as a practical means of making this possible, he ought to find a practical, reliable test method by which steel of good compressive quality can be selected and poor column steel rejected.

One of a Series of Articles on the Details of Design and Layout of Different Types of Industrial Buildings

Santa Fé Freight Terminal and Warehouses at Dallas

Basement Freighthouse Under Four Reinforced-Concrete Warehouses and Office Building—Steam Roller for Asphalt on All Floors — Design Features — Divided Contracts — Concreting Plant

EXTENSIVE railway terminal and warehouse facilities now under construction at Dallas, Texas, for the Gulf, Colorado & Santa Fé Ry. (A., T. & S. F. Ry. System) and the Terminal Building Corporation comprise an underground freighthouse about 750 ft. long, two eight-story warehouses, one ten-story warehouse and a ten-story loft building which is combined with a twenty-story office building. Fig. 1 shows the office building and adjacent warehouses under construction; Fig. 2 is a basement and track plan of the entire terminal, showing the outline of the several buildings.

A principal purpose and advantage of this plant is

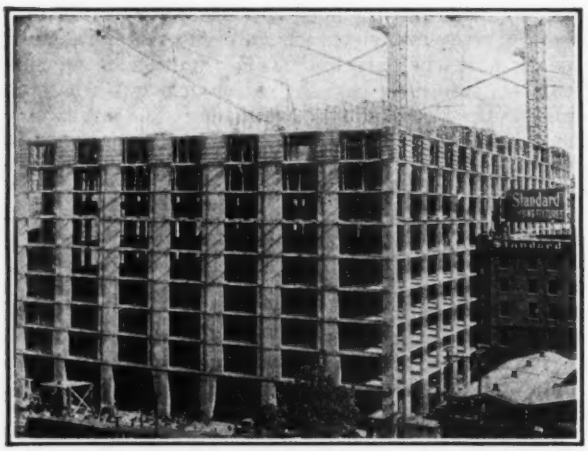


FIG. 1—SANTA FE TERMINAL AT DALLAS, TEXAS, UNDER CONSTRUCTION
Rear of warehouse No. 2; note tapering wall columns in first story.

the economical provision of railway and warehouse facilities in a central location of the city, but free from any surface tracks. It will provide large and small firms with equal accommodations and convenient service, including a package car service furnished by the railroad for local freight distribution to all railroads entering the city. The arrangement for the underground freighthouse is the first step of the City Plan Commission in securing the removal of all railroad tracks from business thoroughfares, as noted in *Engineering News-Record*, Oct. 9, page 580.

Office and Warehouse Buildings—Reinforced concrete is used for all the buildings, with light buff face-brick and white terra cotta for the exterior, while the office building has a high mansard roof sheathed with copper. The warehouse floors are designed for a 200-lb. live-load, except that this is increased to 300 lb. for the first floor, which will be the upper deck of the freighthouse and will carry heavy team and truck traffic. For office floors, the live-load is taken at 50 lb. The concrete bridges carrying the intersecting streets over the freighthouse, at basement level, are designed for a 350-lb. live-load or a 20-ton roller. The story height, measured from floor to floor is 11½ ft.

Foundation conditions are simple, as solid blue limestone rock is found generally above the basement level. Excavation for the basement included 60,000 cu.yd. of rock and 40,000 yd. of earth. The bases of the columns have a taper enlargement to form footings of such area as to give a limit load of 20 tons per square foot on the rock. Except for the brick fire walls, the interior partitions are of hollow tile and metal lath with plaster. Building 1, the office and loft building, has the interior plastered throughout, but the other three buildings have paint applied directly on the concrete and masonry.

Exterior columns are mainly of rectangular section, conforming closely to the sizes of the pilasters or wall piers. This shape, with columns made slightly thicker than the normal wall thickness, gave areas large enough to require only vertical reinforcement, although in some cases spirals also were used. The column spacing is in general 20x23 ft. c. to c. The majority of the interior columns are circular and the largest are 38 in. in diameter. The tapering offset wall columns in the first story (see Fig. 1) constitute an unusual feature, the purpose of which is to carry loads from an equal spacing of columns in the upper floors to an irregular spacing in the basement. This arrangement was necessitated by the track layout. These offset columns throw compression into the second floor, for which a strut is provided, and heavy tension into the first floor, for which extra tension steel is provided.

The minimum of ½ to 1 per cent of steel in both spirals and vertical reinforcing was used, except that in the lower stories these percentages had to be increased. Gravel concrete of 1:1½:3 mix was used in the spiraled columns and 1:2:4 in laced columns. For the columns without spirals a compressive working stress of 500 lb. was assumed. Many small vertical bars were used in preference to fewer large bars.

Floor Construction—For the floor system, a flat-slab coffered ceiling type was adopted, reinforced in two directions. It was designed according to the specifications of the Joint Committee on Concrete and Reinforced Concrete, except that the column capital and drop panel were replaced by a flaring column head of such profile as to provide resistance to shear and bending equivalent to that of the regular column cap and drop panel. This design is shown in Fig. 4. The column heads were made by sheet metal forms and while these were rather expensive in first cost, the final cost was reduced materially by the fact that they could be used many times. The flaring column cap is said to be of pleasing appearance and less conspicuous than the ordinary cap and drop panel.

Reduction in weight was the purpose in using the coffered ceiling type of slab, and the expense of the special form construction required was kept down to a reasonable average by making the forms in several sections which were moved from story to story. In general the slabs were 8½ in. thick with 2¾-in. coffers, giving a central thickness of 5¾ in. Compressive stress of concrete in bending was taken at 750 lb. and tension in

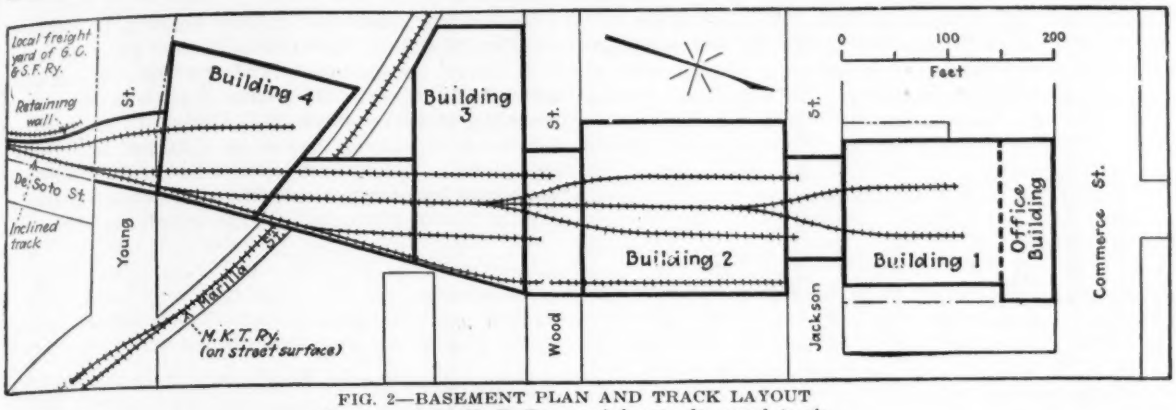


FIG. 2—BASEMENT PLAN AND TRACK LAYOUT
Streets and M. K. T. Ry. carried over depressed track.

steel at 18,000 lb. for intermediate grade steel. Bars of high-carbon steel were used in some parts of the structure. Small bars were adopted whenever possible, in preference to larger bars. The bars for the slabs were bent before being delivered.

A departure from ordinary construction is the absence of spandrel sections in the warehouses. On account of the unusually wide wall columns, the spandrel span was materially reduced, and this condition, with extra stiffness in the slabs in a direction perpendicular to the walls, relieved the spandrel slab sections. They were further relieved by the large window areas and the use of light spandrel walls of hollow tile with a veneer of brick laid on edge. In most cases the floor slab extends through the wall and forms an exposed concrete belt. In the taller office building, which is only 70 ft. wide in the upper floors, deep inverted spandrel beams provide for stiffness and wind stresses.

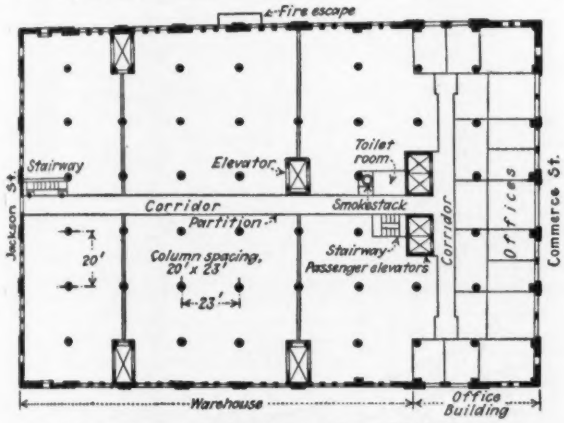


FIG. 3—TYPICAL FLOOR PLAN OF WAREHOUSE AND OFFICE BUILDING

Asphalt Flooring—A distinctive feature of the buildings is the use of a flooring of Texas rock asphalt, which is leveled and compressed by mechanical means. This material is used not only for all floors, with the exception of the lobby and corridors in the office building, but also for all driveways, ramps, freight platforms, sidewalks, stairways and tunnels. An interesting detail of this work is that the hot mixture was delivered in 1-ton trucks which were elevated to the several floors, where the material was spread and then compacted by a 3-ton three-wheel steam roller, as with street paving. For spaces inaccessible to this roller, two hand rollers of 900 and 1,200 lb. weight were used.

A 1-in. asphalt surface is used for the office floors, 1-in. for the warehouse floors and 1½-in. for platforms and driveways. In the office building the asphalt was finished with a floor surfacing or grinding machine, in order to expose the natural dark gray color of the asphalt rock. Tile and terrazzo flooring is used for the lobby and corridors in the office portion of building 1.

Freighthouse and Mechanical Equipment—From the general plan, Fig. 2, it will be seen that an incline track on a grade of 1 per cent, along the DeSoto St. side of the local freight yards, runs down to the freighthouse, which extends under the entire basement area of the warehouse buildings and the streets separating them. It is, in fact, a double-deck freighthouse, the tracks and car platforms being in the basement and the team driveways and platforms on the first floor, opening from the streets. The trackage layout, as shown in Fig. 2, is sufficient to accommodate eighty cars.

All switching will be done by a fireless steam locomotive, charged from a high-pressure boiler under the office building. One charge will be sufficient for four or five hours' operation. This plan is a great improvement upon the use of an ordinary switching locomotive, as contemplated originally, for which reason the buildings were at first designed with ventilator shafts 2x20 ft. placed adjacent to the elevator shafts and extending the full height of the building in order to carry off smoke and steam. There will be twenty-one elevators for handling freight, besides the four passenger elevators in the office building. The freight elevators vary from 6 tons capacity at 100 ft. per minute to 3 and

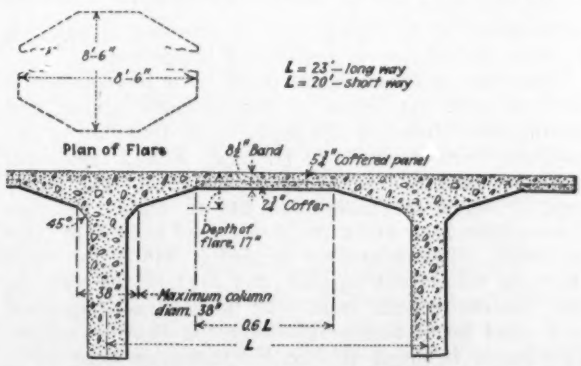


FIG. 4—COLUMN HEAD AND COFFERED CEILING

1½ tons at 125 ft. per minute. All fire doors at elevator shafts are brought flush with the inside facing of the columns and the brick walls are formed with a reveal to allow for free sliding. No sprinkler system

The mixing plant was located between buildings 3 and 4, with a 1-yd. motor-driven mixer in a pit about 12 ft. below the basement level, serving a bucket in a 240-ft. steel tower. The main line chute from this tower delivered concrete to buildings 1 and 2. For building 1 all concrete had to be re-hoisted in a 280-ft. wood tower, which was carried up as the building progressed and from which the concrete was delivered directly to the forms by a boom counterweight chute

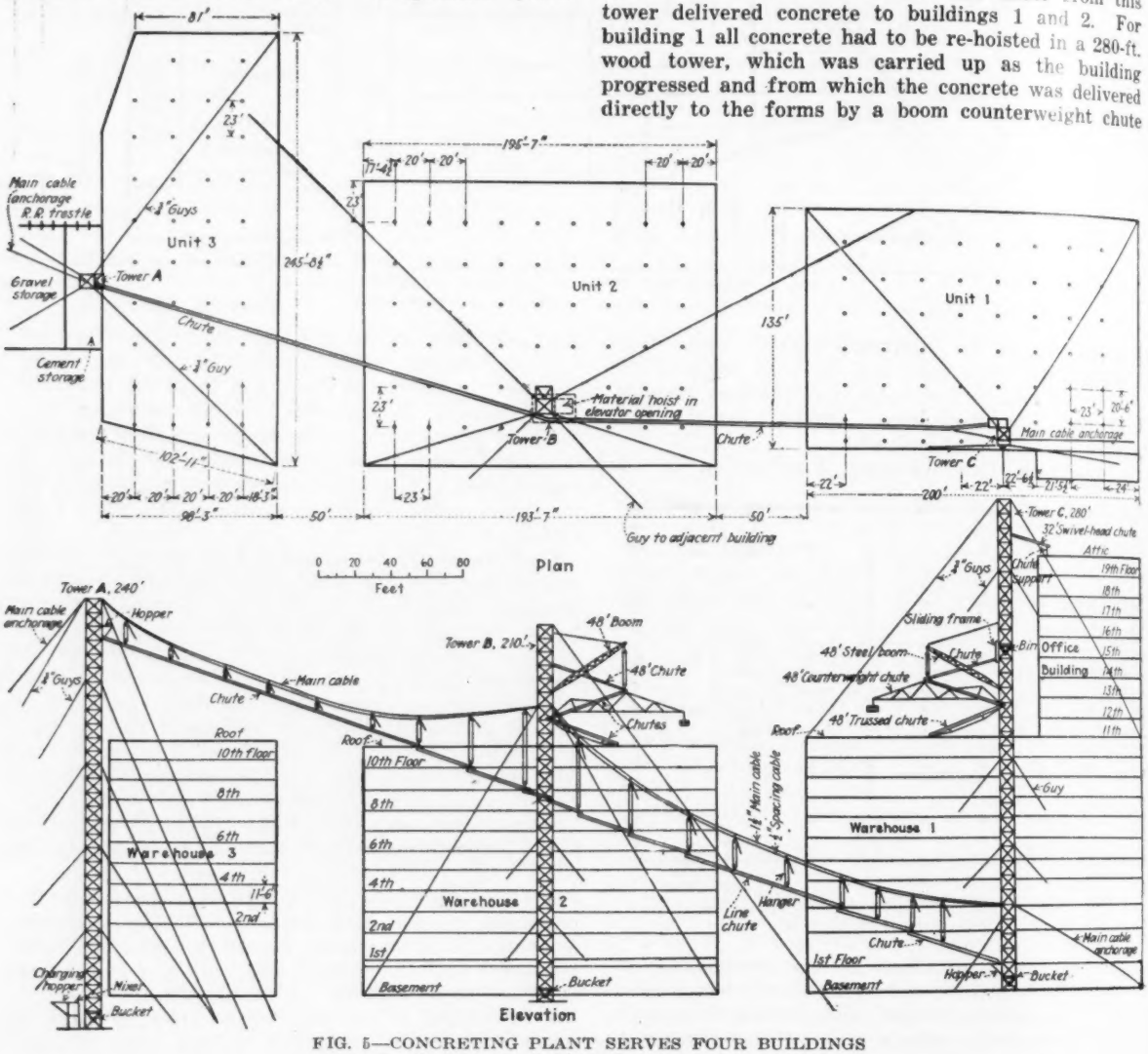


FIG. 5—CONCRETING PLANT SERVES FOUR BUILDINGS
The fourth tower, to the left of tower A, is not shown.

is installed. Cold storage will be provided in building 3, with the necessary mechanical equipment.

Construction Plant and Methods—For the concreting on this work the layout of the concrete mixing and placing plant involved the problem of distributing the concrete over an area 840 ft. long, with a maximum width of 242 ft., comprising the group of four buildings, of which the tallest was 243 ft. high. Between these buildings or units, the streets had to be kept open for traffic. The contractor decided to handle the work from one central mixing plant and to chute the concrete over the entire area from four towers, each equipped with steel boom and counterweighted chuting outfits. This layout is shown in Fig. 5. Materials were delivered by cars on tracks at the street or first floor level, about 18 to 24 ft. above the basement. To provide gravity handling, about 200 ft. of trestle 20 ft. high had to be built, but otherwise all materials would have to be trucked nearly half a mile.

of 140 ft. radius. For building 2, about half of the concrete had to be re-hoisted through a 210-ft. steel tower, which was erected to its full height at the start in order to provide a support for the cable of the main line chute. From this tower, the concrete was delivered to the forms by another boom counterweight chute of 140 ft. radius. For building 3, a boom counterweight chute was attached to the main hoisting tower and served by its bucket. For building 4, the concrete was delivered from the main tower by a secondary main line chute to a 210-ft. steel tower having a boom counterweight chuting system.

Storage capacity for about 2,000 cu.yd. of gravel and sand was provided behind the mixer. Cement was stored in a shed of about 1,000 bbl. capacity adjacent to and over the mixer platform, but so arranged that cement could be delivered while pouring was in progress. Aggregate was delivered from cars into the storage bins by gravity and flowed thence by gravity

into measuring hoppers over the mixer. All materials, including water, were measured and each batch was kept in the mixer for about one minute.

The one 28-ft. mixer when working at full capacity kept practically a steady flow of concrete in the chutes. Hoppers for receiving concrete to be re-hoisted were made of ample size to hold all concrete in the chutes in case of stoppage. Electric equipment was used throughout, except that in building 2 a small amount of concrete was re-hoisted by means of a steam hoist. This concreting plant was run almost continuously at times in order to keep pace with the form builders. Its longest continuous run was sixty hours, though there were numerous runs of 24 to 36 hours. With

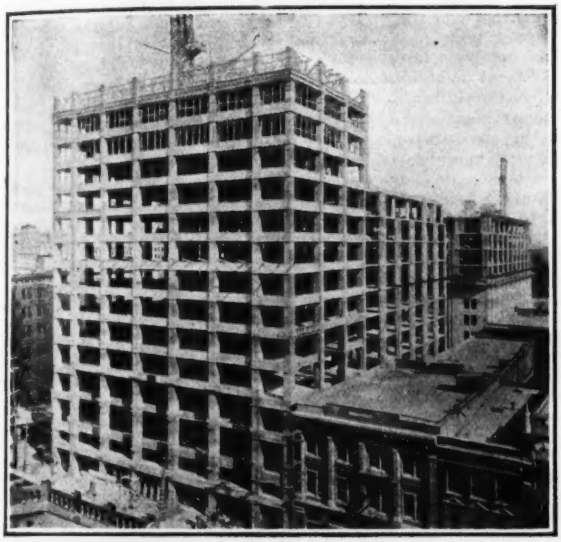


FIG. 6—OFFICE BUILDING END OF TERMINAL UNDER CONSTRUCTION

favorable weather, the average time for concreting from story to story was about nine hours. The most rapid progress was the placing of 520 cu.yd. in ten hours.

Formwork was of wood, except that the usual circular metal forms were used for interior columns and special metal forms for the column heads. A panel system for the flat slabs was devised by the formwork sub-contractor and panels built at shops from detailed plans were delivered on the work ready for use. Some of these panels were in fair condition after having been used ten times. This method of procedure was made practical and economical from the fact that all the four buildings have typical bays. Reinforcing steel was delivered bent to shape and in some cases fabricated, only a small amount of bending on the job being required. The steel was hoisted to the floors by means of a tractor operating a line over a boom swung from the concreting towers.

After pouring, the forms were left in place for 14 to 21 days as a rule, the time of removal being determined by the results of test cylinders taken by the contractor from each column and slab pour. These tests were made because the specifications called for a certain strength as well as a certain mix of concrete. Several hundred of the cylinders have been made and have shown uniform and satisfactory results.

Division of Contracts—It is interesting to note that this extensive work, which is said to be the largest construction job ever undertaken in the Southwest, was handled by local contractors under careful engineering supervision. In addition to the principal general contract awarded to the Watson Co., there were four independent contracts: (1) excavation, Vilbig Co.; (2) mill work, Ingram & Co.; (3) reinforcing and structural steel and miscellaneous ironwork, including placing, Austin Brothers; (4) marble, tile and terrazzo work, W. A. Jacobie Co. The Uvalde Rock & Asphalt Co. laid the asphalt flooring. The formwork and masonry were sublet by the general contracting firm, which handled the concreting with its own force. For the Watson Co., the work was in charge of A. R. Hawkins, engineer, and J. C. Buchanan and T. M. Watson as superintendent and assistant superintendent.

This subdivision of the contracts made the position of the architects very similar to that of a general contractor who sublets most of his work, as the correlation of all these several independent contracts is not ordinarily included in the architects' services.

Engineers and Design Development—Another point of interest is the development in the structural design of this enterprise, which was originated by local business men, including Lloyd R. Whitson, architect. They secured an agreement with the operating department of the Gulf, Colorado & Santa Fé Ry., and later obtained financial backing from the Atchison, Topeka & Santa Fé Ry. System, the latter requiring that all plans should be approved by its engineering department. To check the original steel reinforcing plans as prepared by the Joor Engineering Co., of Dallas, Mr. Whitson then engaged Prof. G. A. Maney, of the University of Minnesota, as consulting engineer. The revised plans were submitted to the railway and were checked under the direction of C. F. W. Felt, chief engineer, and A. F. Robinson, bridge engineer, of the A., T. & S. F. Ry. System. With the modifications then suggested a final set of structural plans was prepared under the direction of Mr. Maney, and bids were invited on these plans.

When work was started, Mr. Maney was made superintendent in charge of construction for the architects and R. T. Summers was assistant engineer in charge for the railroad. Under their joint direction the plans were again checked and somewhat modified in view of certain changes to provide for additional tenants. With this careful re-design, the amount of steel was kept within the original contract calling for 2,800 tons.

Under the direction of F. G. Pettibone, vice-president of the Gulf, Colorado & Santa Fé Ry., the track layout was planned by F. Merritt, chief engineer, and John L. Starkie, assistant chief engineer. Plans for the heating, plumbing, mechanical and electrical equipment were prepared by R. F. Taylor, mechanical engineer and checked by L. L. King, electrical engineer for the A., T. & S. F. Ry. System. In the architectural design, E. A. Harrison, architect for the A., T. & S. F. Ry. System, was associated with the original architects, Lloyd R. Whitson and F. Cowderoi Dale, of Dallas.

This railway terminal and warehouse plant, estimated to cost $5,000,000, is owned and operated by the Terminal Building Corporation, in which both the railway and local interests are represented. The first unit (office and warehouse building) and the second unit (warehouse) are nearly completed. The other two units (of which No. 3 will be largely for cold storage) are under construction and will be finished next spring.

Bureau of Standards Reports upon Technical Investigations

Research of Interest to Engineers Contained in Annual Report of the Director of the Bureau, Now Available

IN THE annual report of the Director of the Bureau of Standards, covering the 1923-1924 fiscal year, there are contained a number of paragraphs of particular interest to engineers and contractors. The following paragraphs are abstracted from the report, which was released Nov. 21. The report is available from the Division of Publications of the Department of Commerce, Washington, D. C.

Magnetic Testing of Wire Rope—Rope investigations for which appropriation was made by Congress have been actively prosecuted. An advisory committee composed of representatives of national technical societies, government departments and large users and manufacturers of wire rope, was organized and has been of great assistance in outlining the investigation. The method which appeared to be most promising is the method of magnetic analysis. This method has received a great deal of study as a non-destructive method for testing iron and steel products but it was at once recognized that no magnetic method has yet been developed which gives results that are unambiguous and capable of definite interpretation.

Corrosion of Underground Pipe—In 1922 an extended and continuous investigation to determine the causes and mechanism of the corrosive action of various kinds of soil on underground pipe was started. About 13,000 specimens have been buried in 46 typical soils throughout the United States selected by the Bureau of Soils, Department of Agriculture. During the year about 900 specimens have been uncovered and returned to Washington for examination and study. Results so far obtained indicate that in certain soils in the South and Southwest initial corrosion of iron and steel is rapid. It has also been found that lead is seriously corroded in a few localities.

Fire Resistance of Theatre Curtains—A complete research on the fire resistance and general effectiveness of curtains used in theatres to close the opening between the stage and the auditorium in case of fire on the stage has developed conclusive information as to the type of curtain necessary to afford adequate protection to the audience.

Braking Systems on Motor Vehicles—There has been a national awakening of interest in the importance of adequate braking systems on motor vehicles. Recording and inspection decelerometers were developed at the Bureau to permit measurement of the braking ability of automobiles. Representatives of the Bureau have been invited to explain and use these decelerometers at demonstrations carried out in several of the larger cities. The result has been increased information among city officials and the public, which will promote greater safety of traffic.

Elevator Interlocking Devices—An investigation of elevator interlocking devices requested by the city of Baltimore which was in progress during the previous year, was continued throughout the past fiscal year. Effective elevator hoistway door interlocks would, according to the best available statistical information, eliminate about three-fourths of the elevator accidents fatal to the public. While most modern elevator codes make the use of such devices mandatory, at least for passenger elevators, the approval of the particular devices used has been based principally on a visual inspection. The purpose of this investigation is to develop test methods for determining the fitness of such devices by actual reliability performance tests in place of visual inspection, and to apply such tests to the interlocking devices now commercially available.

Sound Transmission Through Building Materials—Heights of wall and floor construction which will prevent sound from being transmitted appreciably from one room to another would increase the comfort and efficiency of millions of our people. A comprehensive investigation of the subject is now under way, and experiments are being conducted in a sound chamber especially constructed for the purpose. Measurements are made through panels 7½ by 6 ft. in dimension which are sealed into a corresponding opening in the large sound chamber. The first measurements have been made with panels and simulating present day wall construction, both lime and gypsum plaster being used. The work is being carried on in co-operation with the National Lime Association and the National Gypsum Association.

Strength of Masonry Walls—An extended investigation of the strength of masonry walls is in progress, covering 8- and 12-in. walls constructed from common and medium brick, sand-lime, and building tile. Three kinds of mortar are also being tested, including lime mortar, cement mortar, and a mixture of lime and cement in equal parts. Test walls 9 ft. high and 6 ft. long are constructed, allowed to age 60 days and then loaded to failure in a 10,000,000-lb. testing machine.

Investigation of Welded Rail Joints—Progress has been made in connection with the investigation of welded rail joints. Tensile tests have been made in the large Emery machine, and the anvil and other equipment for the repeated impact tests have been installed. The circular test track, has not been built because of the high construction cost.

Stress Distribution in Ship-Plate Joints—In co-operation with the bureau of construction and repair of the Navy Department a study of stress distribution and elastic action in riveted ship-plate joints has been started. The large Emery machine is being used for this work.

Quality of Concrete—In co-operation with the Portland Cement Association, the Joint Committee on Concrete and Reinforced Concrete, and a committee of concrete contractors, a thorough field test was carried out on two major building operations to establish a means of introducing into practice some of the improvements in the technique of concrete making which recent researches have indicated to be desirable. The investigation also gave interesting results as to the quality of the concrete which is being made on these jobs from hour to hour. . . . In addition to the field work carried out a comparative set of specimens was made in the laboratory from the same aggregate and cement, and these studies were supplemented by one dealing with the effect of curing, time of mixing, method of handling, etc. In general, results showed that a high quality concrete is obtained. In one case the average strength of the 1:6 concrete was 2,200 lb. per square inch in 28 days, and in the other job, the concrete of the same proportions but of different materials gave 3,150 lb. per square inch. The maximum variations of the daily averages of strength were 23 per cent below and 34 above the grand average in the one case, and from 47 per cent below to 30 above in the second case.

Workability of Concrete Mixtures and Tests of Colorless Waterproofing Materials—Two other notable pieces of work of the cement section were those dealing with the workability of concrete mixtures, and with colorless waterproofing materials, for stone in particular. The data obtained in the latter have been issued as Technologic Paper No. 248. The results indicate that those materials which utilize paraffin, aluminum stearate, or mixtures of paraffin with sandalwood oil give good waterproofing values when properly applied. A special feature of the work in connection with the study of the workability of concrete mixtures consisted of incorporating various admixtures into the concrete mixtures and noting the effect of these. The results show that the workability of a concrete mixture is about equally benefited by one part of celite, two parts of kaolin or three parts of hydrated lime such as is used in these tests, if the consistency as measured by the flow table is kept constant. These mixtures in the proportions used did not seriously affect the concrete of the one to four or leaner mixtures.

Investigation of Plaster Failures—A number of kinds of failure of plaster which were brought to the attention of the Bureau have also been the subject of investigation. As is usual in the case of failure of materials of this type, the cause is generally found not in the material itself, but in the attempt to use it without a proper knowledge of its qualities and of the variations in the material which may be present from time to time. In this particular type of material there is marked evidence that the industries concerned could confer a great benefit upon the using public through their service departments by a system of education of the workmen as to how to use the commodity they are placing on the market.

Metal Coating—The work on coating materials of all sorts with metallic coatings by spraying primarily for the Army and Navy has had marked success. A special portable truck carrying a self-contained metal spray outfit has been rigged up for the Army Air Service. Several spray guns have been built and delivered to different branches of the Navy and several very useful applications of metal spray to Navy problems have been worked out. No activity of the division has aroused more interest among the industries although on account of the confidential nature of much of the work publicity has been avoided rather than courted.

Strengths of Glazing Glass—Approximately 500 samples of glazing glass (2 by 18 in.) of various types were tested for strength by transverse loading and impact. The modulus of rupture varied from 5,000 to 13,000 lb. per square inch, and the Young's modulus from 550,000 to 16,670,000 lb. per square inch, depending upon the type of glass. Tests were also made on 12 by 12-in. pieces of glass mounted in frames and loaded at the center. Results show that the strength of these sheets approximates closely that which may be concluded from the strengths obtained by testing transversely strips 2 by 18 in. when tested as a beam supported at two ends.

Bond Between Hollow Tile and Concrete—The results of a series of tests of slabs of hollow tile with reinforced-concrete ribs indicated that the bond between the concrete and the tile was sufficient to cause the tile to assist materially in checking both bonding and shearing stresses. When medium or hard tile is used, it appears that the shells of the tiles which are in contact with the concrete are as effective as an equal width of concrete.

Seasonal Operation in Construction Industries—The study of seasonal construction was initiated about the beginning of the fiscal year at the instance of a committee of the President's Conference on Unemployment. With the assistance of the committee and of the experienced men whose services were contributed by trade associations an extensive report was prepared and served as the basis for recommendations by the committee. . . . Constructive remedies based mainly on what has been accomplished in various communities were evolved and are being tested.

Cambridge University, in England, Has Engineering School

IT IS NOT generally known in this country that the University of Cambridge, in England, has an engineering department, but from an article in *The Engineer*, of London, Oct. 24, 1924, it is learned that the university has had a course in engineering since about 1891 and that since the end of the war it has been put on a definite basis, with an average registration of about 500. A new building has recently been completed which comprises mostly a laboratory and shops, but which has provisions for future additions in the way of lecture rooms, recitation rooms and a drafting room.

The theory of the engineering course at Cambridge is somewhat different from that in the technical schools in the United States. It is aimed at giving, not a specialized course in engineering, but a general basic engineering education utilizing to the greatest extent the scientific instruction facilities afforded by this oldest of scientific colleges. Quoting the article in *The Engineer*, "Specialization during the normal course is only permitted to a limited extent in the third year, and the tendency is to push this specialization more and more into a post-graduate course and thereby obtain additional time for the average student to study and master thoroughly the many and ever-increasing fundamental principles which must form part of the mental equipment of any engineer who nowadays can claim to have a well trained mind. The watertight compartment system of education whereby subjects are dealt with separately and in succession is likewise discouraged. The various subjects are all worked out simultaneously with a view to showing their interrelation.

"In the first year's course the subjects are naturally treated in an elementary manner and a considerable portion of the teaching at this stage is directed toward working students up to a certain standard in mathematics and mechanics. In the second year the theory appertaining to electricity, structures, mechanism, hydraulics, metallurgy, etc., is gone into more fully, and in the third year the courses of instruction are designed to interest students in the practical application of the theories they have assimilated during their first and second-year courses. In the third year, courses in engineering chemistry, industrial economics and geology are also provided. A two years' course of lectures is given by the professor of aeronautics.

"In the Tripos examination by which a student graduates with honors, he is tested as to his knowledge over the whole range of subjects dealt with in his three-year course. An examination of this sort is a searching test which cannot be met by any short preliminary process of cramming. A student who does well in this comprehensive examination is not at that stage a specialist in any one branch of engineering, but, on the other hand, his mental balance is such that he can launch forth with equal facility in any direction and when he ultimately takes up some definite line of work, his broader education and greater versatility will enable him in most cases to overtake and outdistance the man who has been a specialist from the start of his engineering education.

"A limited number of students who have the time to spare spend a fourth year in the department mainly occupied on research, and for students of more than normal ability this is a course which is strongly to be recommended whenever circumstances render it possible."

It is interesting to note also that the engineering students at Cambridge are distributed fairly evenly among the numerous colleges and that these students figure prominently in the athletic activities of the university. For instance, last year half the crew of the university boat, about the leading athletic honor that can come to an Oxford or Cambridge man, was recruited from the engineering departments. Students receive the greatest part of their instruction in the engineering school or laboratory, but all the colleges have supervisors in engineering who supplement departmental teaching with private tuition, which means that the peculiar system of collegiate instruction obtaining in Oxford and Cambridge, whereby tutors carry on small classes, extends also to the part of the engineering work at the university.

It should be remembered that in Great Britain, engineering is less of a specialized profession than in the United States, and that the term engineering is more generally applied to what we understand as mechanical engineering than to civil engineering. Having this in mind, it may be noted that the graduates in engineering at Cambridge seem to have no difficulty whatever in obtaining positions when they leave college; in fact, the condition common in recent years to our engineering college prevails, in that all graduates are sought in the month preceding their graduation by numerous of the leading industrial establishments of Great Britain.

Notes on Western Reclamation—II

An Inspection Trip Summary

This article, on changed conditions in reclamation, tells of some southern projects. The first article, which appeared Dec. 4, described general conditions and northern projects.

By W. W. DeBERARD
Western Editor, Engineering News-Record

COTTON is king on the southern reclamation projects. With it come the attendant problems of tenantry, large land holdings, and the labor and race problems of the South. Yuma, Phoenix and El Paso are the outstanding reclamation points in that region. All three projects are going concerns, but each has its own distinctive characteristics.

Yuma is hot. Few white men ever go there to make a home. Phoenix, the most successful of projects, is now entirely on its own; it is prosperous and confident, and advertises an income from waterpower earnings to owners of water rights. El Paso, the premier health resort project, has the most successful of colonization methods carried out through the Gateway Club.

Both Yuma and El Paso have in the course of years to come to face an international problem of no small dimensions, and it would be as well if some of our Washington friends recognized that fact and appointed level-headed high-class engineers on international commissions rather than lame-duck politicians. The Mexican Commission at Juarez is headed by the brilliantly talented engineer Señor G. Serrano. When I called on him a copy of *Engineering News-Record* lay on his desk, and he began to ply me with questions about an airplane survey story, since he was making preparations for such a survey on the Rio Grande. They know the task before them, down there, and measure up to it.

Yuma—You arrive at Yuma at midnight and leave at the same hour. In consequence early and late impressions are not so distorted by temperature as they might be. It's a wise scheduling of train service, whether intentional or not. This same heat (it's always been up to 110 to 120 in the shade whenever I have visited Yuma) has a bearing on the project's life. No one calls Yuma home. "Back East," or Los Angeles, or Pasadena, or some other place, is invariably claimed to be home. Still Yuma prospers. The Indian village that I saw on my first visit, fifteen years ago, when I came to see H. W. Blaisdell's mechanical slow sand filter and the construction work on the Laguna dam, has grown into a progressive city, with pavements and real houses (no longer adobe).

In Yuma cotton is king with a vengeance. The slump of 1921 is over, and this year more than a thousand automobiles have been sold. Porter J. Preston is the canny, efficient superintendent of this project, and he watches bank deposits each month like a Wall St. financier. I asked for a chart which I happened to see in his office, and send it with these notes. It tells better than words that the Yuma farmer is in no position to dodge his obligations to the government. That is not so much of a problem at Yuma, although the Work-Davis-Cannon propaganda hurt here as elsewhere. Charges can be collected if Washington will keep its paternalistic hands off. For the year ending June 30, 1924, collections from all sources for the project totaled the tidy sum of $759,000.

Tenantry is the big problem. The size of farms owned by one man (perhaps it would be better to say controlled by one family, for the names of one's relatives are utilized for land-holding purposes to the limit) is too large. Tenants are too numerous, and the problem is to get the farms into the hands of those who now work them or would work them. Mr. Preston has a scheme of listing a number of farms, with the government taking an option to sell at a given price. If enough owners will do this, then the government will be in a position to bring in people with the assurance that they will not be victimized by speculators. In the listing the owner is required to fill out a long questionnaire as to the status of the property, improvements, distance to paved roads, shipping point, quality of soil, crop conditions, values taken off during each of the last seven years, mortgages, taxes, and such other information as a prospective buyer should know.

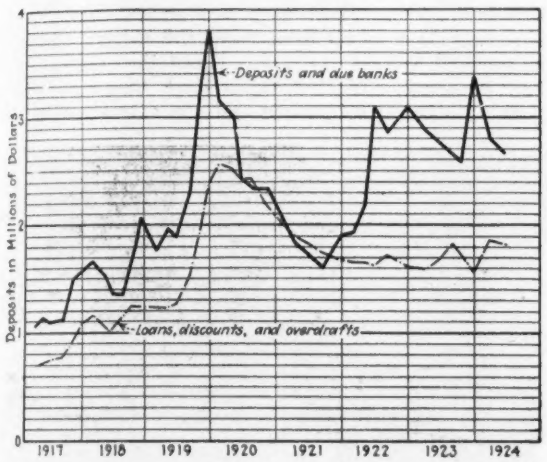
Citrus orchards, costing $1,500 to develop, are the only crops the high-cost pumping project newly developed on Yuma Mesa will stand. Syndicate development seems now to be about the only feasible means. I journeyed out to this project with Mr. Preston and an elderly couple who had made a "selection." He was a moderate-salaried man, she a silver-haired refined Western enthusiast. The absolute impossibility of this couple getting a paying orchard out of uncleared land in seven years without the expenditure of $1,500 per acre of cold cash came to me over and over as we tramped across the blistering sand for a few hundred feet and then quickly returned with relief to the shelter of Mr. Preston's car. But it can be done—and has been done. We ate grass-green grape fruit, the sweetest I ever tasted. This fruit will be yellow and ready for the Thanksgiving market, and its fancy price will net the owner $500 to $800 per acre. The stakes are high, and the gamblers in consequence are not so timorous. I do hope my silver-haired friends live to cash in on their 20 acres. Personally, I would be better suited with producing orchards nearer Pasadena, where they live, at half the price. Development on this mesa land, be it said, can only be had by syndicate action. Already a number of owners have pooled interests and the syndicate is operating. More syndicates are being fostered by Mr. Preston.

Standing before a wall map in the old thick-walled cool military fort I had the pleasure of having the international questions involved in the Colorado River controversy explained to me. The pregnant significance to the United States of the proposed $25,000,000 All-American Canal, and the necessity of having our brainiest men handle the situation, impressed me the more after I had been to Juarez, some days later.

Then on that map was pointed out the trouble the

Colorado itself is working up for us. Silt deposition is lifting the river bed higher and higher, until eventually it will again break through its self-built banks and proceed on a destructive rampage. Both Theodore Roosevelt, who ordered the former break closed, and Eues Randolph, who did it, have gone the long, long trail. New spirits will have to be found when the next emergency arises—for arise it will.

That is the flood menace ahead. The opposite, the menace of drought, came this year, when the flow for Imperial was far from sufficient and many farms suffered. With Los Angeles wanting 1,500 sec.-ft. of Colorado River water and not able to get it without cheap power to lift the water 1,350 ft. over the divide, stronger arguments than ever are going to be put forth for large-



BANK SITUATION ON YUMA PROJECT FOR SEVEN YEARS
The figures are for four solvent banks at Yuma, Somerton and Gadsden.

scale control and development upstream from this trouble zone.

Phoenix—Not much can be said about the Salt River project in reviewing reclamation difficulties. With 240,000 acres of cultivated land (130,000 in cotton this year), valued at $250 per acre, producing an annual average of $23,500,000, the government gets its money without trouble. Since the Water Users' Association was formed in 1903 nearly $6,000,000 has been collected, with a total delinquency of 0.2 per cent. Although the association has the power, not a single delinquent case has been foreclosed. Water is refused when assessments are delinquent.

C. C. Cragin, the dynamic manager of the association, was enthusiastic over the new power-developments at Mormon Flat and Horse Mesa, which will permit squeezing all the power out of the irrigation water stored back of the Roosevelt dam. The Mormon Flat dam is practically completed, and Mr. Cragin was jubilant over the sale of bonds for the 300-ft. Horse Mesa dam, which is to develop 40,000 hp. As the Inspiration Copper Co. has contracted to take all the power for 25 years at 0.65 cents per kilowatt-hour, and for 15 years to pay annually not less than $565,500 (over twice the bond interest!) even though there is an unprecedented drought, it is not an idle dream for the Salt River farmer to expect future water dividends instead of water assessments. However, the speculators long ago were alive to the situation, and raw lands are bringing Iowa and Illinois war-time prices. They (the speculators) will get the gravy.

Other big things are ahead of Phoenix and southern Arizona within the next few years. The merger of the Southern Pacific and the El Paso & Southwestern means the construction of 165 miles of road at a cost of ten to fifteen million dollars. It will make the new main line of the Southern Pacific pass through Phoenix and miles of irrigated lands. The proposed 220-ft. $15,500,000 San Carlos dam on the Gila River near Florence was authorized by the last Congress, for the storage of water estimated to irrigate 80,000 acres of land, one half of which belongs to the Pima Indians. The Salt River Valley is being populated. Ten families a week is the rate of influx. The millions being spent on the above developments make life one long sweet dream for the publicity boosters in chambers of commerce.

At Phoenix one ought to get the "other side" of the Colorado River controversy. Yes, one does, I thought, as I stopped to view a model of Maxwell's hair-brained scheme to bring 30,000 sec.-ft. of water through 360 miles of canals and 80 miles of tunnels to irrigate 3,500,000 acres of land. There it was. A little red line running around, over and through the roughest mountain country a model builder ever laid out, let alone God Almighty when he fashioned northern Arizona. And this is the kind of engineering with which Phoenix housewives are fed up when they go to buy their provender! Col. William Kelly, chief engineer of the Federal Power Commission, in the hearing before the House Committee on Irrigation and Reclamation, stated that the grand total of the cost of the scheme would be $1,774,500,000. Why waste an engineering Munchausen concept like this on housewives?

Unfortunately such nonsense is (or has to be) given as much attention in congressional hearings as legitimate proposals. Arizona has a lot of land tributary to the Colorado, but not much water falls on it and runs into the Colorado. Several million acres of land in the state might be irrigated. She holds control of the Colorado now, and before it is developed and the benefits go out of the state she is sure to make the best bargain possible for royalty on power and for water diverted. The recent re-election of Governor Hunt, who is openly opposed to ratification of the interstate Colorado compact, means that little progress can be made for some time. The best opinion seems to be that James B. Girand will get his permit from the Federal Power Commission for the Diamond Creek dam, and that the Utah Light & Power Co. will be next with the Flaming Gorge power project. Boulder Canyon and other schemes require more money than is available.

El Paso—In El Paso cotton has increased 37,000 acres in 1923, 75,000 this year; there will be 100,000 acres next year if the price keeps up. A new warehouse compress and fumigator will care for the crop.

How to handle immigration and select the settlers seems to have been solved for the Rio Grande project by the people themselves. As in other southern projects, lands accumulate in the hands of bankers and business men of the cities. About a year ago these men organized the Gateway Club; 800 or 900 men subscribed $150,000 for publicity and proceeded to hire an experienced newspaper man, August Wolf, as manager. Wolf got busy on ads and literature to tell the truth. Every bit of it was submitted for check to L. M. Lawson, project superintendent. Aside from that

(and personal interest) the Bureau of Reclamation has had nothing to do with the promotion work.

The club has brought 850 families to the district. Not all are farmers, but the newcomers have been added to the community. Ads are run in quality magazines, in local newspapers in large centers such as New York, Boston, Chicago and Denver. On arrival the prospect is met at the train by one of the 350 members of the hospitality committee. A doctor is met by a doctor, a farmer by a farmer, and so on. Engineers, I understand, are plentiful. Farmers are frankly told that $3,000 to $5,000 is necessary to tackle a ranch. Renting is advised the first year. Labor is cheap—$1.50 to $2 per day. Bank loans are not so hard to negotiate. Practically none of the 850 families that came have left. The big holdings are being sold off, and homes are being made, without any paternalism. The tenant problem is being reduced. Most of the newcomers are of American stock, though a large party of Bulgarians, some time in this country, recently made application. In operation, as soon as the prospective settler has become sufficiently interested to want to talk sales he is turned over to the secretary of the Realty Association, who assigns the prospects in rotation to one of the eighteen members.

Perhaps the most favorable factor in the success of the Rio Grande project is the spirit of self help which Mr. Lawson has engendered and fostered in the project settlers. Early he induced them to organize districts. That eliminates the financial burden of collection from the Bureau. The district collects in advance and pays the Bureau in a lump sum. Mr. Lawson sells the necessity of engineering service so well that the farmers petition the government to carry out drainage work or better the service.

Joe Taylor, successor to the late H. H. Brook as president of the Elephant Butte Irrigation District, happened in the day I was there. "We are strong for the engineers," he said. "They save us from many foolish mistakes we would make. We do not want the Bureau to turn over everything to us. There are too many vital structures and situations that need expert attention at critical times of flood and drought."

As I left El Paso on my dusty trip to Kansas City, it was with a good impression of the Bureau. The people at this gateway to our sister republic are working out their own problems—the proper American way.

As a general conclusion from my trip—We have some good projects; but by all means let us settle up what we have before embarking on any more ventures unless the project is of superior type. In the matter of laws, once more the necessity of delegating to local representatives more (rather than less) authority seems essentially the right thing. The dual system must go. These engineer managers do not need their activities curtailed, but should have them enlarged. Give them more responsibility. They can carry the load!

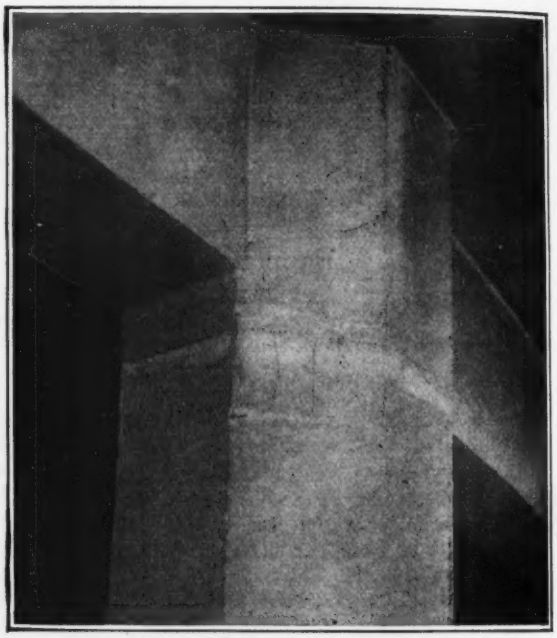
Railway Mileage of the World

Of a total length of 741,175 miles for all the railways of the world, the United States has 252,236 miles, or 34 per cent, according to a statement issued by the Bureau of Economics. These figures are for the end of 1922 and include: Canada, 40,491 miles; South and Central America and the West Indies, 79,014; Asia, 77,961, Africa, 33,629, Australia, 29,203; Europe, 228,641 miles.

Prompt Column Repair Prevents Building Collapse

Poor Workmanship in Pouring Reinforced-Concrete Columns Appears After 15 Years When New Floors Are Added

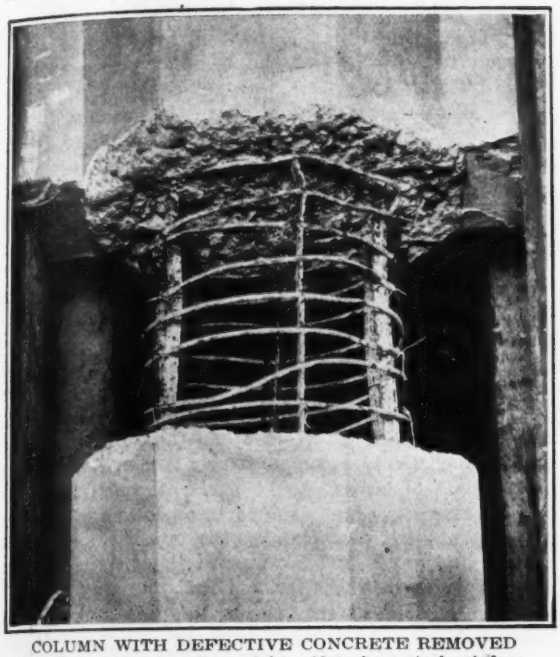
FOUR FLOORS were recently added to the reinforced-concrete Holland building in Seattle, which was built four stories high in 1909, according to a design that provided for the later addition of the four more floors. When the addition was nearing completion the interior columns in the old building began to crack and show signs of failure near the top. A system of timber shoring was quickly designed and put in whereby interior columns on all floors were entirely relieved of their load. These shores were kept in place while defective concrete was removed from the column tops and replaced with good material. Since the columns have thus been reconstructed there have been no further signs of distress or failure and the entire building is now in service. The building is 60x111 ft. in plan and has 12 interior columns on each floor with 16x20-ft. bays between columns.



CRACKS IN COLUMN TOP BEFORE REPAIR STARTED
Note plaster spalling off and deep cracks developing in the concrete and extending downward from several points around the column on the same level.

It is believed that had it not been for the concrete side walls, when the additional load was put on the building would have collapsed before its dangerous condition could have been recognized and remedied. As it was, the structure was dangerously near collapse, because the entire load of old and new structures, inside the side walls, was for a time carried largely by the reinforcing steel in the columns.

The wall columns were designed to carry the total dead- and live-load of floors and tile curtain walls built of concrete. The wall column footings were continuous and parallel with the property line so that the basement wall and concrete curtain walls had complete bearing



COLUMN WITH DEFECTIVE CONCRETE REMOVED
Shores are carrying the weight. Note how steel reinforcing bars have been bent and deflected by compressive stress.

on the continuous column footings. These concrete walls carried the total dead- and live-load from the five original floors, thereby reducing the wall column loads from these floors to zero. The unit stress actually occurring in the walls was about that required for common brick, so that while these wall columns and concrete walls showed concrete of approximately the same quality as that in the interior columns the unit stress was so low that the walls and wall columns did not show any indications of stress or failur

The concrete in the floor joists and girders was not a good quality of 1:2:4 concrete, as was determined by cutting holes for the shores, but there were no serious or unusual indications of distress or failure in the joists or girders. The originally designed live-load for the floors had been reduced 25 per cent and this had reduced the unit stress in the floors, curtain walls and columns.

Fortunately a very heavy spiral steel wrapping had been used in the original columns and this plus the fact that the fireproofing was double the usual thickness in the upper floors enabled the four stories of the original structure to carry their own live- and dead-load for 15 years. When the dead-load of the additional floors came on, the "concrete" in the top of the old columns was crushed and thus left only the reinforcing steel to carry the entire load until emergency relief measures could be applied.

Records of the original construction showed that the design of the structure was in accordance with the best practice of the time. The columns were proportioned in accordance with the Considère formula and the spiral hooping was one per cent of the column area, while the vertical steel ran from 2 to 2½ per cent. The extra thickness of fireproofing referred to was due to the fact that the same forms were used in the columns on all floors of the original structure and this made the upper columns larger than the design called for and gave four instead of two inches of concrete around the steel on the upper floors.

The cause of the defective concrete is ascribed by engineers in charge of repair to excessive agitation or "churning" of a very wet mix when the column forms were filled. No other explanation, it is believed, could account for the fact that aggregate that should have been in the tops of the columns was found from 2 to 6 ft. below the top while the material in the column tops was largely sand with very little cement in it, overlaid by cement which was porous and of about the same strength and hardness as ordinary wall plaster. In other words, where the cement was separated from the sand and gravel apparently it had not had opportunity to harden properly. The churning had given opportunity for small, light particles to come to the surface and a coating of laitance was found on the very top of each pour. This was such as is commonly found on the surface of concrete that has been agitated before setting began and not cleaned off afterward. However, in addition to this laitance, a considerable volume of cement, as already noted, was found in streaky, lens-like formations above the sand and other coarser materials. Chemical analysis showed this to contain nothing foreign to good cement, and analyses of samples of different color and hardness showed the same chemical content, indicating, according to engineers in charge of the work, that the difference was primarily in the quantity of water in the samples at time of setting.

Another fault in the column construction was that the column forms were over-poured in many cases and

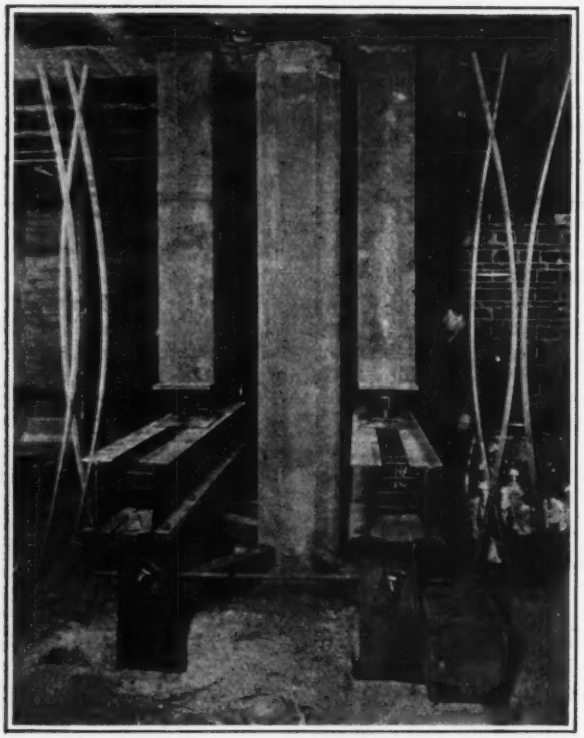
TYPICAL MAIN AND FLOOR-SYSTEM SHORING
Main shores were put through holes in the floors from basement to fifth floor, while each floor system was carried on secondary shore systems as shown here.

the laitance flowed into the bottom of the forms for the beams in the floor above, thus putting the plane between successive pours in the beams instead of in the columns themselves. As a result, layers of such poor material were frequently found on the under side of beams that it was crushed by shores put in to carry the weight of only one floor. The engineer who designed the building apparently did not have any supervision over construction and there is no record of any inspection having

been given to this structure by the city building department.

The amount of material removed from the columns before reaching good concrete varied from 2½ in. to 8 ft. of column length. In every case material was cut away until a good quality of hard concrete was encountered and then the surface was well roughened up to afford good bond.

When the serious condition of the old structure was



TOP OF MAIN SHORES ON FIFTH FLOOR

The single shores above are carrying the load of the newly added floors. Note tierods and struts keeping shores in place. Also note bowed scantlings with pointed markers, used in lieu of extensometers to indicate any floor sag.

realized plans for shoring were speedily prepared. Due to the clay tile fillers in the floors and to the soft material that had run out in the bottoms of the beams it was impossible to shore directly from the footings through the girders to the roof. Holes had to be cut through the floors from the top of the fifth floor down to the basement, and 10x10-in. shores were run directly from the foundation through the floors to the upper or top floor of the old structure.

On the fifth floor loading beams and jacks were put in place and all the new work above was picked up and carried on the shores here independently of the old building. The weight of each floor was carried to the main shores by jack shores, put in about 5 ft. below the top of the column on each floor, carrying the weight through post caps and I-beams arranged as shown in the accompanying illustration. These post caps were provided with dowels to engage holes in the shoring timbers, thus guarding against danger of slipping.

In this way the weight of each old floor was conveyed separately to the shores which also carried the weight of the new addition directly from the fifth floor to the foundation. This plan entirely relieved the columns in the old building of their own load as well as of the weight of the new addition. The shores were prevented from separating by tie rods or bolts, while struts between the shores and the columns prevented them from drawing together. One set of bolts and struts was used on each story just above the floor level.

In the four stories added to the old building, shores were also used, two beside each column, each shore carrying a jack to put it in bearing. This made it possible to lift the load off the top floor column in the old building without danger of shearing off the beams under which the shores were placed. The shores in the new addition were put in bearing before load was taken by the shores below. Most of the jacks used were of 25-ton capacity.

In putting in new concrete a 1:2:4 mix was poured into forms clamped around the old columns until a space only about 2 in. high remained to be filled. This space was formed up on three sides and through the opening on the fourth side a comparatively dry mix, consisting of one part of cement to 1½ parts of coarse sand (up to ¼-in. diameter) was tamped into place, beginning by tamping against the form on the opposite side of the column and working back toward the opening. After some experience it was learned that by using a mix of just the right consistency and by tamping it only lightly the grout could be wedged very firmly into place and seemed to harden very quickly; in ten days grout so placed was hard enough to give a sharp ringing sound when struck with a hammer. After new concrete had set not less than ten days and gave a satisfactory ringing sound under the hammer the shores were removed.

An interesting feature of this work was the sag indicators used on the fifth floor in lieu of extensometers. These consisted of 1x2-in. fir scantlings of a length such that they could be braced between floors when slightly bowed. By using these in groups of three and putting double-pointed sticks between the bowed scantlings at the widest and narrowest points, respectively, there was improvised a simple but very accurate telltale device. A group of three of these scantlings was set up at each column on the fifth floor. Once adjusted, the attendant knew that so long as the longer pointed stick remained in place there had been no settlement in the series of shores below. The slightest settlement, on the other hand, resulting in a sag of the floor above, would cause these scantlings to bow further apart and release the stick whereupon the attendant would take up this sag by turning up the jacks until the second or shorter stick dropped out which indicated that the spacing between the scantlings bowing toward each other had passed the original setting. Having thus compensated for settlement in the shores the pointed sticks were replaced and again watched for settlement.

F. F. Sinks, consulting engineer, Seattle, designed the shores, devised the "extensometer" just described and supervised the reconstruction, assisted by T. E. Phipps. Stuart and Wheatley were the architects, and McRae Brothers the contractors.

Production of Sanitary and Electrical Wares

Sanitary ware, including bathtubs, washtubs, etc., but excluding fixtures, valued at $27,017,675 is included in the $114,384,733 of total valuation of the pottery products of the United States reported by the 1923 Census of Manufacturers, conducted by the U. S. Department of Commerce. Porcelain electrical supplies account for $21,981,831 of the total product.

Tunnel Enlargement on a London Tube Railway

Annular Shield Takes Slice Around Bore—Lining Reused with New Segments—Wet Ground Causes Caving

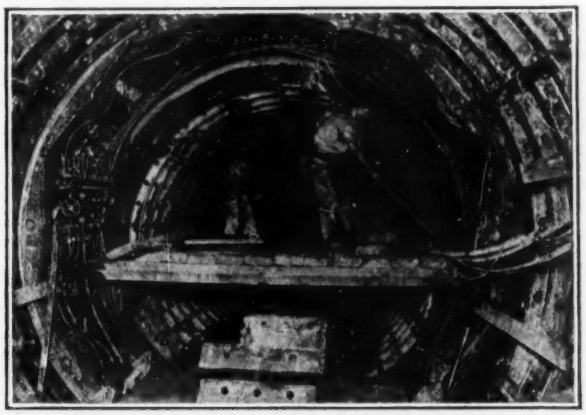
ENLARGING two old iron-lined single-track tunnels is a novel engineering feature in the improvement of the complicated system of subways or tube railways in London, England. The tunnels are those of the City & South London Ry., the first of the London "tube" lines, and their diameter of 10 ft. 2 in. has kept them isolated from the later numerous and interconnecting lines having tunnels 11 ft. 8¼ in. in diameter. This enlargement was undertaken, therefore, in order to provide for through routing. The tunnels have the usual lining of cast-iron segments, each ring in the South London tubes consisting of six main segments with a key piece at the top. These rings are taken down as the work of enlargement advances and are then replaced, but with new supplemental segments to give the increased diameter.

A tunneling shield of the Greathead type is used and is of annular shape to allow trains to pass through, since at first the traffic was not interrupted and the work was done only during a few hours each night. As the result of a slide, however, that part of the line under alteration was closed to traffic, between certain stations, so that work could proceed continuously. The shield is 10 ft. 8 in. and 12 ft. 10 in. in internal and external diameter, with ten hydraulic rams. Its length is 7 ft. 5 in., including the cutting edge, the ram section and the tail. The cutting edge, a cast-steel ring in three segments, is said to be designed specially to give protection when working in gravel soil; the central section has five segments with a key piece on top to facilitate dismantling. With 1,800 lb. hydraulic pressure, each ram has a force of about 30 tons, or 300 tons on the entire shield. A 23-in. stroke allows for placing one complete tunnel ring at each advance.

When the shield is ready to advance, a ring of the old lining is taken down, and the segments are carried back to the tail, to be cleaned and made ready for re-erection. Pressure is then applied to the rams and the shield advances. As soon as it has moved 20 in., the new and larger ring of lining is erected within the tail; as the shield continues its stroke the small annular space outside the lining is grouted. When work was done under traffic an average of two rings was erected complete during the four clear hours available. In the accompanying view the men are removing a segment of old lining in front of the shield, while in the foreground is a part of the new lining of the enlarged tunnel.

In regard to the caving of this tunnel, noted above, it was known from the records of the original work that there was a weak spot or treacherous ground at this point. For this reason, it was decided to leave the roof in place and to change the tunnel to an oval section, lowering the grade of track to give the necessary clearance. This oval section was needed for only twenty-three rings. In order to adjust the grades, however, it was necessary to continue the section for thirty-one rings on each side and it was assumed that in these portions the roof lining could be removed as usual. Two rings were taken down simultaneously, leaving a gap of 3 ft. 4 in.; this gap was closed by poling boards, which proved to be too short for the loose ground encountered instead of the expected solid clay. A trickling of water was not considered of great importance by the men and no special precautions were taken with the result that flow from an old cistern caused a slip which broke through the timbering over the roof gap in the northbound tunnel and blocked the track.

A report by a government engineer indicated that there were serious errors of judgment by the inspector and foremen in regard to the timbering and the leakage. It is stated that the men were concerned more in relation to the effect of water on their work the next night than as to the stability of the face of the tunnel, and the chief inspector was told that the water would not interfere with the traffic. Furthermore, the incident was treated as part of the ordinary routine and was reported on the usual nightly report of progress, instead of being made the subject of a special communication. It did not come under the notice of the engineering staff for several hours, and the collapse occurred before the matter could be referred to the resident engineer.



ENLARGING TUNNEL WITH ANNULAR SHIELD

Grade Separation at South Bend

For some years the city of South Bend, Ind., has been negotiating for the removal of tracks which run along and across its streets, and the Grand Trunk Western Ry. has entered into an agreement under which it will relocate its line through the city for 2½ miles, between 18th and Arnold Sts. This change will remove the line from Division St., which its tracks now occupy and which is one of the principal streets; it will also include the elimination of fifteen street crossings. The city will pay $391,168 in addition to 25 per cent of the cost of work at street intersections where grades are separated. The railway company has completed its surveys and is acquiring the necessary right-of-way. Under this agreement the work is to be completed by August, 1929. Negotiations are in progress with the New York Central Lines and it is expected that in a short time an agreement will be made for 1½ miles of track elevation between Miami and Chapin Sts., both inclusive, involving the elimination of twelve grade crossings.

New Type of Slab Reinforcement For Concrete Roads

Uniform Mesh Reinforcement Strengthened at Slab Edges by Second Mesh in 18-in. Strips—Major Members Transverse

By C. N. Conner
Construction Engineer, State Highway Commission, Raleigh, N. C.

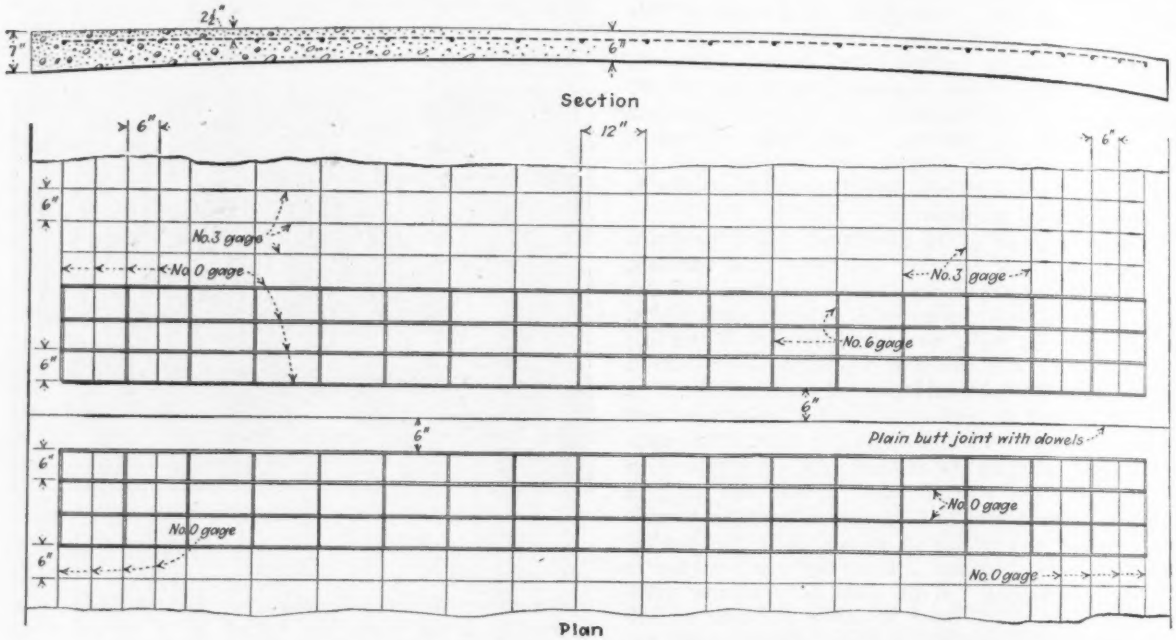
INVESTIGATION and comparison of various types of reinforcing for pavements have been in progress for several years, but up to the present time the area, spacing and location of reinforcement in a pavement are almost entirely a matter of opinion. The design, if such it may be called, is something less than empirical.

All highway engineers have watched with interest the development of the so-called thickened-edged pavement, and it is hoped that where reinforcement is required equal interest will be given to the reinforced type of roadway.

To show the wide divergence of opinion, some engineers are reinforcing their roadway with reinforcement near the top; others with the reinforcement near the bottom; still others with the reinforcement in the top and in the bottom. Different ratios of longitudinal to transverse reinforcement with various spacings ranging all the way from a minimum of 2 and 4 in. up to 24 and 36 in. are used. Some engineers prefer bars, some prefer fabric, some allow either; some require galvanizing of fabric, others do not; some require welded connections, others permit simply a tied joint. It is fortunate, indeed, that the Highway Research Council is now devoting time to this subject and it is hoped that at least some definite principles will be established.

A very important factor in the use of reinforcement is that it should be of such simple design that the contractor may handle and place it at a minimum of cost for labor.

A recent type of reinforced pavement which has been developed and is now in use in North Carolina is shown by the accompanying drawing. This section does away with the marginal bars which had been in use up to this time, places an extra amount of steel near the edge of the pavement and at construction joints where the stresses are assumed to be the greatest. The principal reinforcement is transverse and its cross-section area per foot of width is twice that of the longitudinal giving a 2 to 1 ratio. The weight is approximately 5.3 lb. per square yard or about 59 lb. per 100 sq.ft. This type is used in concrete roadways 16 and 18 ft. in width without longitudinal joints.



CONCRETE ROAD SLAB REINFORCEMENT WITH STRENGTHENED MARGINS

Army Engineers' Attitude on Eads Bridge, 1870

"When the Eads bridge over the Mississippi at St. Louis was under construction, during erection of the arches certain steamboat men protested to the Secretary of War, who assigned a board of engineers to investigate. The board declared the bridge an obstruction to navigation and recommended that either the arches be taken down and truss spans put up, or a canal with a draw span be constructed around the end of the bridge, notwithstanding that there was a clearance of 50 ft. above high water and about 90 ft. above low water. The board said, 'If no change can be made that will satisfy navigation interests, then the bridge must come down and another take its place. A satisfactory bridge could have been erected had not the authors of the present monster stood in the way.' The Secretary of War pigeonholed the report of the board, and it has not been heard of since."—C. E. Smith, in a paper on the history of the Eads bridge, read before the American Railway Bridge and Building Association.

Recent Developments in Railroad Locomotives Discussed

Zoelly Turbine-Driven and Ramsay Turbo-Electric Locomotives Considered in the Light of American Requirements

ACTIVE discussion of recent developments in the application of steam turbines to railroad use took place at the meeting of the railroad division of the American Society of Mechanical Engineers at New York on Dec. 2. It centered around two papers presented for discussion at the annual meeting, one by H. Zoelly, chairman of the board of directors, Escher Wyss & Co., Zurich, Switzerland, and one by George F. Jones and T. Laurence Hale of London, England, on the Ramsay condensing turbo-electric locomotive. The authors of the papers were not present at the meeting, a fact which detracted somewhat from the value of the discussion, as some of the questions which were raised were not satisfactorily answered.

Briefly, the Zoelly locomotive is a rebuilt reciprocating locomotive in which the ordinary cylinders have been replaced by a six-stage impulse turbine mounted transversely on the frame under the smoke box and driving a jackshaft carrying the crank and crank pins through a double reduction gear. Exhaust steam is discharged into water-cooled condensers of the surface type. The condensing water is pumped to a re-cooler situated above the water tank on the tender. The locomotive developed about 1,000 brake hp. A similar locomotive developing 2,000 brake hp. has been built by Krupp, but has not been tested, so no figures concerning it are available.

The Ramsay locomotive is a self-contained electric locomotive in which the power developed by the steam turbine is transmitted to the driving wheel electrically instead of mechanically as in the Zoelly locomotive. It differs from the Zoelly locomotive in that it is an entirely new unit built for experimental purposes and arranged to facilitate the study of the various parts and the substitution of new parts of different design where necessary. Evaporation condensers are used to obtain a 27-in. vacuum.

As the paper concerning the Zoelly locomotive was presented for discussion before the paper on the Ramsay locomotive was read, the greater part of the discussion was devoted to the former.

Discussion—The outcome of discussion was that in considering these developments in locomotive design, we must realize that they are designed to meet European conditions, that in Switzerland, in particular, the cost of fuel is such an important factor that designers are justified in going to greater refinements to increase the thermal-efficiency of locomotives than we are in this country. Moreover, as their power units are relatively small and their track structure equal or superior to ours, they can increase the weight of their locomotives considerably without passing the limitations placed by their track structure, whereas in this country our units are so heavy that we have about reached the limit of concentrated loads. In this connection, it was pointed out that the Zoelly locomotive has a capacity of about 1,000 hp. and the new locomotive built by Krupp has a capacity of 2,000 hp., whereas we in this country are more interested in locomotives with a capacity in the neighborhood of 3,000 hp. The Zoelly and the Ramsay locomotives both have high thermal efficiencies but a low weight efficiency. To develop a turbine locomotive for our needs would, according to some of the speakers, require a double unit with two turbines, because the gearing could not be designed to stand the great strain set up by developing 3,000 hp. in a single unit. This would mean, in addition to great weight, huge condensers. In fact, some of the speakers thought that the size of the condenser required for a 3,000-hp. locomotive was going to be the limiting factor in turbine locomotive design. A unit with two geared turbines has been built by the North British Locomotive Co. at Glasgow under the Reid-MacLeod patents but little is known about its performance as yet.

American Conditions—In the design of such small locomotives, the European builders have not been confronted with problems which immediately would arise in this country in the design of larger locomotives, such as providing for the stresses in crank pins, gearing, and jackshafts. Attention was drawn to the fact that the Ramsay locomotive has no spring compensation in the connection between the motors and the drivers, as has been found necessary in this country.

From an operating point of view, it was said that locomotives of the Zoelly type were not highly efficient in starting and in running at low speed, a characteristic which is very desirable in freight service.

The efficiency of any condensing locomotive when operating through tunnels was questioned. Any reduction would be a controlling feature on maximum grades.

The electrical drive of the Ramsay locomotive gives it an advantage over the Zoelly type of locomotive in the matter of starting and running at slow speed because it is in effect an electric locomotive and has the inherent advantages of a motor-driven locomotive in starting and running at reduced speeds.

Mr. Warren, of the General Electric Co., proposed a combination of the reciprocating engine similar to the one now in use with the tender replaced by a longer unit containing storage space for coal and water and equipped with a low pressure turbine which would use exhaust steam from the reciprocating unit. The turbine would be connected to drivers under the second unit either directly through gears or through electric motors. Mr. Warren figured that the use of such a turbine-driven locomotive auxiliary would increase the capacity of the unit about 80 per cent. One speaker, in referring to Mr. Warren's proposal, said that this would amount to putting a high powered booster under the tender; that boosters under the tender had not been a great success because their tractive effort was reduced as the supply of coal and water was cut down.

Unfortunately no provision was made for extending the discussion to include other recent developments in locomotive design in Europe, such as the Lomonossoff engine, a Diesel-electric locomotive built for the Russian Government in Germany and somewhat similar to but about four times as powerful as the one built for the New York Central R.R., described in *Engineering News-Record*, Sept. 4, 1924, p. 390, the Reid-MacLeod locomotive noted above, built in Great Britain, and the Ljungstrom, an air-cooled turbine locomotive being tried out in Sweden. The Lomonossoff locomotive is designed for use in desert regions where water is of poor quality or entirely lacking.

Large Niagara Turbines Survive First Serious Accident

Foreign Object Carried Into Waterway of Turbine Damages Guide Vanes and Cuts Away Part of Runner Vanes

ONE of the new 70,000-hp. hydraulic turbines of the Niagara Falls Power Co. was temporarily put out of commission recently by an accident which, although not unusual in its character, was unusual in the effect upon the turbine.

Before describing the accident it is necessary, for the benefit of persons unfamiliar with the layout of the new plant, to state that the intakes for the three large turbines are deeply submerged near the lower end of the power canal. In this position there is little possibility of large floating objects getting into the penstocks and consequently screens were omitted in order to prevent a possible shut-down of the plant due to clogging of such inaccessible screens with grass and frazil ice.

Shortly after the third of the new units had been put into operation some foreign object of considerable size, probably picked up by the increased velocity of the water in the approach channels, was carried into the turbine, passed through the guide vanes and got caught in one of the buckets of the runner and swept around with it, breaking the emergency links of a number of the guide vanes before it was dislodged and carried out of the runner. Accidents of a similar character are not uncommon, but heretofore the injury has usually been confined to one of the guide vanes. The emergency link, shown in Fig. 1, has been developed to act as a release in such cases. The small connections in the collar at the center of the link break when some unusual stress is put upon the vane, thus freeing the link and letting it seek a position not far from closed position. Fig. 2 shows the links in place.

The unusual feature of this accident to the Niagara turbine was that instead of one guide vane being set free, several were set free creating a condition under which instead of seeking a closed position, one or more of the vanes swung around into contact with the vanes

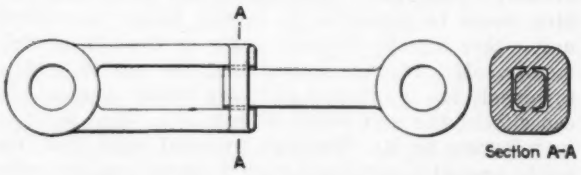


FIG. 1—DETAILS OF THE SAFETY LINK
Failure occurs in the light connection (shown in section A-A) when an undue strain is put on the link.

of the runner and stripped off the entrance edges of the runner vanes.

It is characteristic of all turbines of low or moderate specific speeds that a guide vane when freed from connection to the operating mechanism may be forced into contact with the runner vane, and although when a single guide vane is freed it will seek a position not far from the closed position, this is not true when a series of adjacent vanes are simultaneously set free. In this case they are totally unrestrained and their positions are indeterminate.

As a result of the accident to the Niagara turbine, the new turbines and all turbines of similar construction in the plant have been equipped with mechanical stops to prevent the guide vanes swinging into contact with the runner vanes when the former are set free by an accident.

An inspection of the turbine after the accident showed that the damage was confined to the entrance edges of the runner vanes and the edges of the guide vanes, no injury having been sustained by the casing, distributor plates, draft tube, runner crown or band, or the guide vane stems, and no effect was produced on

FIG. 2—MECHANISM FOR OPERATING GUIDE VANES
Safety links connect the double arms on the upper end of each guide vane stem to the central operating collar.

the runner clearances or on the bearings of the guide vanes or the main shaft bearing. No cracks were found in the fillets joining the runner vanes to the crown or band, and except for the pieces broken out of the entrance tips of the vanes, the runner casting was found to be in excellent condition, and it has already been completely repaired by welding in new pieces.

At the time of the accident the unit continued to carry about 45,000 kw. until it was shut down by closure of the Johnson valve, this closure being completed within 4 min. from the time the first rumbling was heard in the turbine. The 21-ft. diameter Johnson valve functioned perfectly, and owing to the manner in which the operators handled the situation there was no interruption of the service; the switches on the unit were not pulled until the Johnson valve had reduced the load to a low value.

Information upon which the report is based was received from the late John L. Harper shortly before his death.

France Has Too Many Young Engineers

At the present time there seems to be an over-supply of engineers in France due to the large number of young engineers graduated from the École Polytechnique and the École des Arts et Metiers who are willing to work for low salaries to get experience. This fact is making inroads upon the profession of experienced engineers. The Syndical Chamber of French Engineers has gone on record with the following motions: (1) In order that the number of engineers, in France, may be in harmony with the needs of industrial enterprises, it is suggested that parents should not encourage their sons to enter a profession already crowded and that technical schools notably reduce the number of their diplomas; and (2) salaries to young engineers should be only in proportion to their experience and capacities.

Some Recent Developments in Highway Research

Abstracts of Reports of Committees of Advisory Board on Highway Research: I—Working Plan for Transportation Survey; II—Structural Design of Roads; III—Stability Test for Road Soils

Outstanding service is rendered the practical highway official in the work of the committees of the Advisory Board on Highway Research, excerpts from whose voluminous reports—presented at the annual meeting of the board, Washington, D. C., Dec. 4 and 5—are published here. The working outline for a transportation survey epitomizes the experience of the men who have directed the most important of these undertakings. Probably the most elaborate experiments in road design ever projected are summarized in the conclusions on highway structure. There is no greater need today in road design than a simple test for soil stability.—EDITOR.

Objects and Methods of Highway Transportation Surveys

BY G. E. HAMLIN
Connecticut State Highway Commission, Hartford, Conn.

A STATEMENT is submitted by the committee of the objects, methods, costs and equipment of transportation surveys.

I. DATA SOUGHT

1. Highway Administration and Engineering Data

1. To determine daily, seasonal and yearly traffic density and distribution on state highway systems.
2. To estimate future traffic on state highway systems.
3. To determine the relation of traffic density to the factors responsible for the growth of traffic, such as motor vehicle registration, production and population.
4. To classify highways as industrial, high, medium or low type traffic routes and determine design requirements based on (1) passenger car and motor truck density and (2) motor truck capacities, gross loads and prevailing wheel loads.
5. To determine highway width in proportion to traffic.
6. To estimate the extent to which the improvement of old or the opening of new traffic routes is economically justified.
7. To correlate traffic loads and density on the highways with highway construction and maintenance costs.
8. To determine the type and volume of traffic on the highway as an index to the allocation of highway construction and maintenance funds.
9. To determine the amount and frequency of motor truck overloading.
10. To compare the cost of various types of highway improvements such as relocations, grade reductions, elimination of grade crossings (both rail and highway), traffic "bottle necks," with the estimated saving in transportation costs resulting from such improvements.
11. To compare the earning value of the state highway system (based on passenger miles and freight ton miles) with the present worth of the highway system using replacement value minus depreciation as the basis of computing present worth.

2. Highway Economic Data

1. To obtain highway transportation information concerning the volume of tonnage shipped by motor truck and the relation of highway transportation to other types of transportation.
2. To determine the mileage zones of motor truck haulage.
3. To determine the situs of ownership of passenger cars and motor trucks operating over the highway systems.
4. To estimate the value of motor truck net tonnage hauled over the highway system.
5. To determine the type of origin and destination as well as the origin and destination of net tonnage of commodities transported by motor truck over the highway systems.
6. To estimate passenger car business and non-business usage of highways.
7. To determine the proportion of farm traffic on the highways.

II. COSTS OF A TRANSPORTATION SURVEY

The cost of a survey which will furnish data to adequately answer the purposes outlined above will vary with the size of the state, the mileage of highways, relative density of traffic, and the thoroughness with which the highway system is surveyed. The cost will be divided approximately as follows:

1. Administration and analysis of data, 15 to 25 per cent.
2. Field expenses, 75 to 85 per cent.
   (a) Equipment, 15 per cent.
   (b) Salaries of field personnel, 60 to 70 per cent.

III. TYPICAL ORGANIZATION OF HIGHWAY TRANSPORTATION SURVEY

1. Highway transport engineer.
   Duties: Responsible for planning and direction of the survey and supplementary data.
   (1) Assistant transport engineer.
   (2) Office personnel.
   Duties: Responsible for direction of office force in analysis of survey data and obtaining additional data to supplement the traffic survey records.
2. Field manager.
   Duties: Responsibility for field work, general supervision and inspection.
   (1) Division supervisors.
   Duties: Responsibility under field manager for successful operation of one section of area surveyed. In a state the size of Pennsylvania or Ohio, about one-fourth to one-third of state.
   Close and regular inspection and supervision of parties operating in the division. Detailed inspection of all data obtained in division. Each division supervisor has supervision of from three to six operating parties.
   (2) Operating parties.
   Duties: To record prescribed data at specified locations. Parties vary in size from 2 to 8 men and are in charge of a party chief who is responsible for the efficient operation of his party. Operating parties are of two types.
   (a) Recording parties, complete density records on all types of vehicles, detailed information on passenger cars, and detailed information except weights on all trucks.
   (b) Weight parties, all data recorded by recording parties and weight data on all trucks.
   Weight parties operate a sufficient number of stations to obtain samples of truck weights in sufficient numbers to determine accurate average weights, and accurate distribution of weights on various roads. Under average traffic conditions from 30 to 50 per cent of all stations should be weight stations.
   (2) Operation.
   Each station is operated for a 10-hour period one day each month. The schedule of operation is so arranged that operations cover each day of the week. Hours of operation are so arranged that adequate records are obtained for all hours of the day.

IV. Equipment Required

Motor vehicles.
Automobiles for field manager, assistant field manager, and division supervisors.
Light trucks (speed wagons) for weight parties.
Light cars for recording parties.
Portable scales for weight parties.
"Drive On" loadometers or Berry scales.
Miscellaneous small equipment, traffic signs, etc.

V. Data Recorded

1. Weighing stations:
At these stations the following data will be recorded:
(a) Trucks:
Density per hour, state of license, situs of ownership, make, capacity, body width, body type, origin and destination, type of origin and destination, commodity, value of load, type of trucking (commercial trucking company or owner operator), gross weight, front and rear axle weights, empty weight, tire type, tire size, tire depth, and tire impression on pavement.
(b) Passenger cars:
Density per hour.
(c) Passenger buses:
Density per hour, state of license, passenger capacity, number of passengers, name of operating company, origin and destination, mileage, trip time and tire types.
(d) Horse-drawn vehicles:
Density per hour, origin and destination, type of origin and destination, time, commodity.

2. Recording stations:
(a) At these stations all data are recorded similar to weight stations except truck weights and tire information.

3. Passenger data will be obtained by sampling passenger car traffic at all stations. This data will include: state of license, make, type of body, number of passengers, business and non-business usage, long distance touring, situs of ownership, origin, destination.

VI. Data Forms

1. Truck weight sheet.
2. Truck recording sheet.
3. Passenger car data sheet.
4. Density—passenger cars.
5. Density—buses and horse-drawn vehicles.
6. Empty weight cars.

* * *

Structural Design of Highways

By A. T. Goldbeck
Bureau of Public Roads, Washington, D. C.

During the year seven problems have been under particular consideration by different investigators reporting to the central committee. They were as follows: (1) Subgrade Investigations, by I. B. Mullis and Dr. C. M. Strahan; (2) Impact and Static Load Tests on Road Slabs, by E. B. Smith; (3) Theories of Stresses in Road Slabs, by H. M. Westergaard; (4) Stress Measurements in Road Slabs, by A. T. Goldbeck; (5) Fatigue of Concrete, by Dr. W. K. Hatt; (6) Skew Arch Investigations, by A. T. Goldbeck; and (7) Investigations of Motor Truck Impact, by C. A. Hogentogler. The conclusions or indications of greatest significance are:

Subgrade Investigations—It is shown by laboratory tests using areas varying from 1 sq.in. to 9 sq.ft. that the penetrations of several bearing areas subjected to the same intensity of load vary as the square roots of the areas. The applicability of this apparent law to conditions in which the subgrade is of indefinite depth and lateral spread has not yet been demonstrated.

The moisture content in a road subgrade may be increased due (1) to increased surface tension from lowered temperature and (2) to condensation of vaporized moisture due to lowered temperature.

When a layer of granular materials such as sand, gravel, cinders, etc., is used under a road surface on a finely divided soil, the capillary moisture is reduced, and the moisture which might normally form by condensation has practically no harmful effect on this layer.

In general, all of the moisture in soils does not freeze when subjected to low temperatures, the exception to this being clean Ottawa sand. The amount of moisture in a soil which seems to be available for freezing is dependent upon the fineness of the soil, the percentage of dissolved salts present and perhaps other factors.

It has been demonstrated that a layer of finely granular material such as sand, cinders, bank run gravel, etc., is effective in preventing the penetration of a plastic subgrade up through a broken stone or gravel road.

It is indicated that when a soil has a moisture equivalent of above 20 per cent or a lineal shrinkage value of over 5 per cent, such a soil is apt to give unfavorable results and a subgrade treatment such as an inadequate granular admixture or the use of a granular layer would be advisable.

No definite relation has yet been established between the maximum moisture content to be found in various subgrade materials and the laboratory tests for moisture such as capillary moisture, moisture equivalent or capacity moisture.

Heaving and "frost boils" are found to occur in both sand and clay subgrades. Drainage conditions seem to play a more important part than soil characteristics.

Load Tests on Road Slabs—The resistance of a rigid slab to impact depends in part on the supporting value of the subgrade. A subgrade of high and uniform support materially increases the resistance to impact.

The impact resistance of concrete slabs of uniform thickness varies as some function less than the square of the depth.

In the tests as conducted the resistance to edge and to corner impact was about equal.

The resistance to impact of 1: 3: 6 concrete ranged from 60 to 80 per cent of the resistance of 1: 1½: 3 concrete and was considerably more erratic.

Reinforcing steel when favorably placed to receive tensile stress seemed to add to the impact resistance of the slabs tested.

For increasing resistance to impact, small bars seemed to be more effective than large bars when used in like amount.

Although bituminous tops slightly added to the strength of 4- and 6-in. bases on a dry subgrade they seemed to reduce the strength of the pavement on a wet subgrade probably due to the continuously wet condition of the concrete.

Motor Truck Impact—Little impact is to be expected from pneumatic tires on roads of normal smoothness and very little impact even on rough granite block.

High impact ranging approximately from 200 to 500 per cent of the static load is to be expected from solid tires especially after they have been reduced in thickness by wear.

Cushion tires in general have intermediate impact values between pneumatic and solid tires but they range in value depending on their design. Detailed numerical results are rapidly becoming available.

Fatigue Tests on Concrete—Although a number of indications may be drawn from the tests described, the outstanding indication from the standpoint of the designer of concrete roads is that the endurance limit of stress in concrete is approximately 50 to 55 per cent of the static load. In other words the best information still points to the desirability of limiting the unit fibre stress in concrete roads to 50 per cent of the modulus of rupture.

Theory of Stresses—A theory for the complete analysis of stresses in road slabs is not yet available although considerable progress is being made in the development of such a theory on the basis of the mathematical theory of elasticity. At the present time the best basis for the design of concrete slabs is given by the corner theory in which the slab is considered as a beam of uniform strength, the thickness then being expressed by the formula

$$t = \frac{3W}{S}$$

where W = maximum wheel load,
S = ½ of the modulus of rupture,
t = edge thickness.

Also, according to this same theory, when a mutually supporting center joint is used.

$tc = \frac{7}{10}\ t$, where
tc = the center thickness of the pavement.

Stress Measurements—Although a number of detailed conclusions are drawn, the outstanding conclusion is that the highest stress exists at the edges of the slab, very clearly corroborating the conclusions from other studies that a thickened edge is desirable.

Skew-Arch Investigations—It is clearly shown that in designing skew arches it should be recognized that higher reaction stresses will exist at the obtuse angle end of the abutment than at the acute angle and that the greater the angle of skew the greater will be the difference in stress. Thus, for a 60 deg. skew the horizontal and vertical reactions at the acute angle end are both practically zero.

* * *

Disk Shear Test for Road Soils

By C. M. Strahan
University of Georgia, Athens, Ga.

DISKS of relatively large diameter and thin vertical dimension are prepared under uniform conditions of mixing, tamping and final compression. Present standard uses a disk 4 in. in diameter and 1 in. thick, mixed up in moist condition for soils, thoroughly tamped and finally compressed under a total load of 25,000 lb. or very nearly 2,000 lb. per square inch. The disks are dried to constant weight.

The test is made by centering the disk enclosed in a snug fitting steel ring over a circular die opening of ¾ in. diameter, above which a steel plunger accurately aligned with the die and ⅝ in. in diameter is made to force or punch a plug of the material through the die ring.

On road soils, the test is made first on the dry disks, and is followed by tests of similar disks containing specific percentages of water. The water is added and diffused through the disks as follows: The surface of the disk is covered with blotting paper, well moistened. On top of this, a crucible with asbestos filter, is placed. The dry weight of the disks being known, one half of the water needed to give the desired per cent is placed in the crucible from which it gradually oozes out into the blotter and from the blotter is absorbed by the disk. Having thus treated one surface, the disk is turned over and the other half of the water needed is similarly applied and absorbed. During absorption, the disk is kept in a moist closet and left for at least 24 hours in order that uniform distribution of the moisture throughout the disk may be secured. The moistened disk is weighed just before testing, and the increase in weight measures the exact amount of water present. Successive tests with increasing moisture reveal the rate of diminishing shearing strength in the sample. For road soils, the hypothesis is:

The plunger being small compared with the mass of the disk, we are developing a stress distribution mainly of shear and partly of lateral displacement somewhat similar to what occurs on the road when a hard surface layer is pressed by a concentrated load into a weak or unsupported point of the subgrade.

That both the physical bond and adhesive values of the granular and fine ingredients are tested in a significant way.

That the influence of water in lubricating the movement and reducing the adhesiveness will be revealed slowly until enough water is present to cover with a hydroscopic film the surface of the particles, and thereafter its effect would be more rapid. The absolute percentage of water thus becomes a function in part of the granular composition of the material and areas exposed.

That probably a coarse-grained road soil will retain a larger percentage of its strength than a silty or highly clayed soil, when account is taken of the comparative surface areas of the two materials.

That the relation of the die opening to the test plunger should be such that a marginal distance equal to the diameter of the coarsest grain in the sample should be provided on each side of the plunger in order that such large particles may not become wedged in on entering the die.

That probably the supporting test ring instead of being rigid should be of thick rubber in order to permit a greater amount of lateral displacement and thus approximate the field condition of an extensive mass capable of lateral yield. While this point is important, the test results with the existing rings show very consistent breaks on duplicate tests.

Construction Work in Paris

Paris Correspondence

ENLARGEMENT of the St. Lazare Station of the Est Ry. and the demolition of tunnels approaching the station, widening and extension of the Boulevard Haussmann, and projected increases in water supply and sewage disposal are chief construction problems of Paris at the present time.

The biggest work in hand is the demolition of the five short tunnels leading into the St. Lazare Station. The railway is demolishing also a big group of buildings surrounding it in order to enlarge the present station to more than double its present size. In capturing property necessary for the terminal enlargement, more than 1,100 families were forced out of their homes.

The putting through of the Boulevard Haussmann to the Boulevard des Italiens is progressing rapidly. The work is being undertaken in three steps, the first only being finished, that of expropriation and actual demolition, and new alignment of the first section of about 200 yd. The second section will carry the alignment a like distance farther on, and the last will finally join the boulevard with the Boulevard des Italiens.

In connection with the demolition work and the extension of the boulevard, a building company has been organized which has been empowered to build and rent, build and sell, or rent or sell lots assuming for the privilege all the obligations of the city of Paris toward former owners and tenants.

Water-supply problems are becoming rather acute. A new conduit has been completed recently bringing waters of the little River Voulzie to the capital. A project for filtration plants on the larger rivers higher up than the present installations is already considered. Definite efforts are being made to prevent further pollution of the upper reaches of the Seine and Marne.

As to sewage disposal in the lower reaches of both the Seine and Marne rivers the case is quite as serious. The microbic content at Choisy le Roi, just above Paris on the Seine, is 150,000 per cu.cm. and 119,000 at the Port Royal in the center of Paris. At Saint Ouen this rises to 900,000 as these waters receive the flow of the Clichy collector. At Argenteuil, just below Paris, after having received the drainage of the Gennevilliers plain the quantity rises to 10,000,000, which with the drainage of the Achères district brings it up to the formidable figure of more than 60,000,000. A new and extensive plan of sewage disposal is under consideration.

The city of Paris is to borrow 300,000,000 francs for a new housing scheme which will supply high-class workers dwellings at reasonable rents. Already there are on record more than 40,000 requests for rental of such property, although the buildings are only in the plan stage.

Unusually Large Dry Dock for South Africa

South Africa is making provisions for the repair of the world's largest vessels by the construction of a dry dock at Durban, on the east coast, as long as the new dry dock at St. John, New Brunswick, and considerably wider and only 54 ft. shorter than the Boston dry dock, exceeding that dry dock in width by 73 ft. Its dimensions, 1,150 ft. long by 188 ft. wide, make it one of the largest dry docks in the world.

The $39,000,000 Water Project of the East Bay Cities

Dam 340 Ft. High, 81 Miles of Pipe Line, 9.5 Miles of Tunnel—New Water Supply to Be Delivered in Four Years

RATIFICATION of the $39,000,000 bond issue for the Mokelumne River project to furnish water to Oakland and other East Bay cities in California at the election Nov. 4 was the first step toward the construction of one of the most unique municipal water systems in the West. A mountain water supply stored in a reservoir formed by a high dam on the Mokelumne River, near Lancha Plana, at El. 565 ft., would flow through an 81-mile pipe line for the most part 5½ ft. in diameter, to the hills back of the East Bay cities, thence through 9.5 miles of 9-ft. tunnel into existing catchment reservoirs adjoining the Bay cities, or, if desired, to the Claremont distributing reservoir direct, by a small addition to the tunnel. The spill from the Lancha Plana reservoir would flow over a natural gap to Dry Creek where it might be stored for irrigation in an excellent reservoir site which could be developed to any desired capacity up to 1,000,000 acre-feet.

While it is possible to deliver water from the Mokelumne source into the East Bay district by gravity, this is not considered by engineers of the district to be the most economical method. Because of the great length of high-pressure steel pipe that a gravity plan would require, it is stated that the most economical method is to bring the water by gravity to the foot of the Coast Range, and there pump it about 200 ft. to an elevation from which it will flow to the district reservoirs by gravity. The cost of pumping is estimated to be less than the interest on the increased cost of the aqueduct capacity to bring the water all the way by gravity. The present plan of the district calls for an aqueduct made up as follows:

	Miles
Steel pressure pipe	57.0
Concrete pressure pipe	8.5
Non-pressure aqueduct	2.6
Pump pressure pipe	2.0
Tunnel	2.1
Steel pressure pipe	11.0
Lafayette tunnel	3.6
Claremont tunnel	3.8
Total	90.6

These are the main features of the new water project which has come to the fore rather suddenly but which has met with widespread approval in the East Bay cities, as shown by election results. Previous reference to the project appeared in *Engineering News-Record*, Oct. 2, 1924, p. 559. The resumé of the history and chief features of the project here given is based on information from Arthur P. Davis, chief engineer of the East Bay Municipal Utility District, and on the report by Alvord, Burdick & Howson, referred to in the following:

The discovery of the Arroyo Seco reservoir and dam site on a drainage area paralleling that of the Mokelumne affords opportunity to assemble the rights of the water users on both streams in the valley below. The 340-ft. Mokelumne dam will raise the water to sufficient elevation to carry surplus flows over a divide into the Dry Creek watershed. All existing water rights can be taken care of by the large reservoir and in addition 200,000 acres of new land can be irrigated in the fertile fruit country below the foothills. In case this land does not take the water, sufficient water will be available to push back salt water which rises in the Sacramento River during low-water periods and causes difficulty considerably above Antioch where a bell is rung when the brackish water enters the local water system. The reservoir on the Mokelumne will furnish ultimately 200 m.g.d. for the East Bay cities but the project can be developed successively, beginning with 50 m.g.d. and building it up as may be needed by the addition of a second conduit with a capacity of 75 m.g.d. The third 75-m.g.d. unit can be a duplicate of the second unit.

The water-works project is entirely separate from the storage and irrigation project on Dry Creek, its only relation to the latter being the interesting natural opportunity to spill the water from the Mokelumne River at Lancha Plana over into the large reservoir on another watershed. This phase of the development would involve extensive flood control advantages affecting the lower river and would be a factor in Sacramento Valley reclamation work.

The preliminary plan of the Lancha Plana dam calls for an arch section with 500-ft. radius. It will be placed in a gorge 30 ft. wide at the bottom and 900 ft. wide at the top on a hard and dense green stone schist. The reservoir will impound 200,000 acre-ft. It is estimated that the dam, which will require about 500,000 cu.yd. of concrete, can be built in four years. It is only necessary to build about five miles of railroad to connect it with good transportation. The pipe line can be built, the engineers estimate, in three years; existing facilities for constructing steel pipes in the East Bay cities now being capable of extension to produce one mile per week. The 9 or 10 miles of tunnel will require at least a three-years construction period and possibly four.

The story of the discovery of the dam site and reservoir paralleling the Mokelumne reads like fiction. In 1910, Charles W. Landis, a young civil engineer, formerly with the U. S. Reclamation Service, owned a farm in Dry Creek near the reservoir site. It was damaged by a flood carrying sand and debris from mining operations upstream. He started to investigate. It occurred to him that what was needed was a large reservoir in which to impound the sand and debris of the mines, and it also occurred to him that the Arroyo Seco basin, more than six miles wide in places, might constitute such a reservoir. He made many trips of inspection and found that the Arroyo Seco was indeed a natural reservoir which could be enclosed largely by a single dam in Dry Creek, in part on the Landis farm. A dam 150 ft. in height was possible. The next problem was to find water to fill the reservoir and Landis set out to find a dam site on the Mokelumne, which he finally located four miles above the old mining camp of Lancha Plana in the Mokelumne Canyon, a site apparently overlooked by all of the former exploring engineers. The magnitude of this problem led Landis to interest A. J. Cleary, formerly chief assistant engineer on the Hetch Hetchy project, who saw that a supply for the East Bay cities would give it impetus.

Cleary and Landis then secured the assistance of Stephen E. Kieffer, consulting engineer, San Francisco, and with his assistance capital was interested, surveys made, preliminary plans were worked out and the necessary lands and rights were optioned. At this stage of the undertaking Alvord, Burdick & Howson,

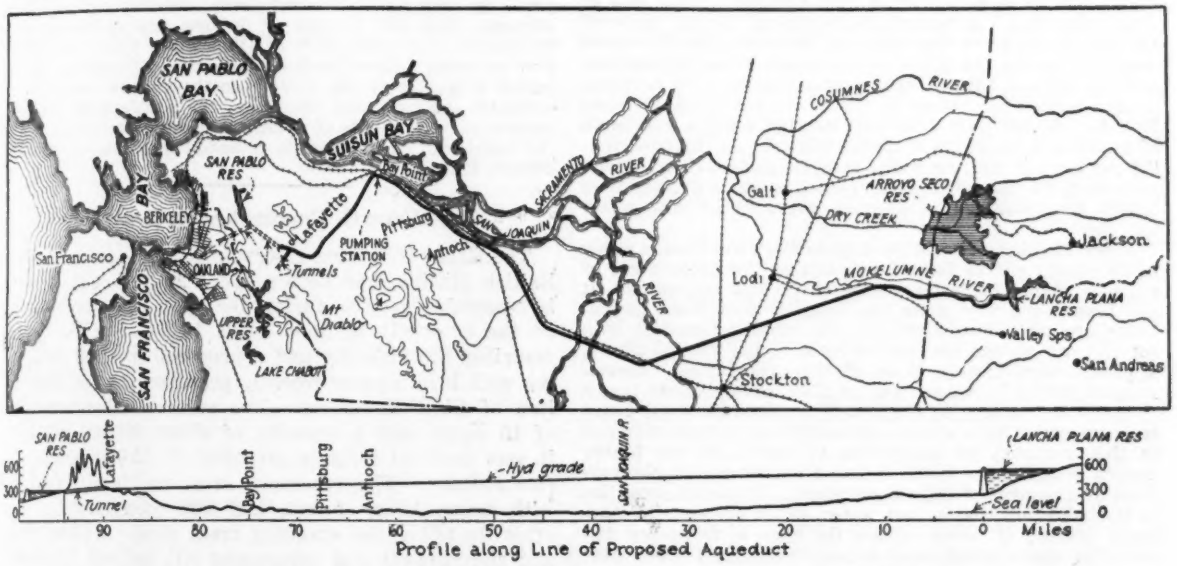
engineers of Chicago, were called upon for expert opinion and report upon the feasibility and cost of the project and its desirability as compared with other available supplies.

This report was completed in March of this year, and later turned over by Kieffer to the engineering board of the East Bay Municipal Utility District, of which Arthur P. Davis is chief engineer. The engineering staff of the Utility District thoroughly investigated the project and made its own comparisons with other practicable projects. Later in the summer the Utility District, on the advice of its Board of Consulting Engineers, consisting of Mr. Davis, George W. Goethals of New York and William Mulholland of Los Angeles, adopted the Mokelumne River project for the supply of the East Bay cities. This was followed by

6. The water may be delivered into the Claremont reservoir close to the heart of the consumption district, at an elevation sufficient to serve by gravity the great majority of the population in the Utility District.

7. It is desirable, so far as possible, to retain the capacity of the Coast Range catchment reservoirs of the East Bay Water Co. for the storage of flood waters originating on these watersheds, as originally intended. It is practicable, however, with the Lancha Plana project to fill the San Pablo reservoir, if desired in excessively dry periods, thus storing over a year's supply at the present rate of consumption from this reservoir alone.

8. The whole project, including the dam and supply line, is readily accessible throughout its length. A 4-mile railroad extension will reach the site of the



THE LANCHA PLANA WATER PROJECT FOR THE EAST BAY CITIES

the ratification of the necessary bond issue at the Nov. 4 election.

The Alvord, Burdick & Howson report points out that this project has the advantage that it would not be dependent on political action by any other city or district than that directly interested in its successful outcome. Of other notable advantages cited in the report some of the more important are summarized:

1. It is a water-supply project pure and simple separate and distinct from power or any other controversial aspect. It is primarily directed to the provision of pure, potable, soft mountain water.

2. Its source is 40 miles nearer the center of population served than any other mountain water supply hitherto proposed.

3. If promptly begun and pushed it can be introduced for use in four years' time, about one-half of the time believed necessary for other mountain water projects.

4. It can be progressively built; the greater part of the expenditure can be made as the water is needed. It is therefore not necessary to suffer extensive loss on unused construction.

5. The water meets with popular approval. It is admirably adapted for domestic use without filtration. It will be one of the best waters for industrial use supplied to any of the cities of this country.

Lancha Plana dam without crossing a large stream. Pipe for the conduit lines can be delivered by barge at four points, so located that short truck hauls are involved.

9. It can be early adopted and realized, thus relieving the public anxiety now felt. The time of completion is only limited by the time required to build the tunnels and the Lancha Plana dam. There is manufacturing capacity in the Bay district capable of building 800 ft. of conduit per day, and plant capacity can be easily enlarged to supply one mile of conduit per week.

10. When the East Bay district reaches a population of one million it will occupy more than twice the present area. This occupancy will be largely on the lands of lower elevation. The supply conduit will traverse a large part of this region. It can supply numerous large industries badly in need of water at the present time and will attract the location of others, thus building up a great distributing center of the transmountain region easily accessible to rail and water transportation.

11. There is a market now available adjoining the supply line throughout its route from Lancha Plana to the East Bay cities. This market is now ready and can be utilized so far as desired by the Utility District in selling any surplus water during the development period of the project.

Filter Loading Studies on Ohio River, by Government

Progressive Increase in Bacterial Counts—Chlorine Enables Plants to Give Safe Results—Last Barrier Reached

Abstract of paper by H. W. Streeter, sanitary engineer, U. S. Public Health Service, presented at the Fourth Ohio Conference on Water Purification, Nov. 14.

A YEAR'S survey of the filter plants on the Ohio River forming a part of studies by the U. S. Public Health Service of the limitations of current water purification processes was completed in June. Daily bacterial examinations at the several plant intakes indicate that the river is most highly polluted bacterially in the vicinity of Ironton, Ohio, where the average B. coli index during the year of observations was 14,900 per 100 c.c. Two other zones of high pollution were found; at East Liverpool, Ohio, and at Evansville, Ind. A remarkable reduction in the bacterial content of the river was observed between East Liverpool and Steubenville, 22 miles downstream. Wide fluctuations, both in daily and in monthly average numbers of bacteria, were noted at all points in the river, the monthly mean B. coli index at East Liverpool varying from a maximum of 11,600 to a minimum of 18 per 100 c.c. At Ashland, Ky., 7.4 per cent of the raw water samples gave a B. coli index exceeding 100,000, while at six plants an index greater than 10,000 was observed in over 10 per cent of raw water samples.

Rapid Multiplication in the Higher Ranges—From a study of frequency curves formed by plotting the percentages of samples giving bacterial counts of various magnitudes, it has been found that when the logarithms of these magnitudes are plotted as abscissas, the resulting curves, both for the raw waters and the effluents of the several plants, approach very closely those of the symmetrical "normal frequency type." An analysis of these curves shows that a progressive increase in the yearly average bacterial count is accompanied by a disproportionately large multiplication in the frequency of occurrence of counts in the higher ranges, a deduction which is borne out by recent observations at a number of Ohio River plants. Its significance lies in its indication that a raw water, or an effluent, the bacterial content of which follows the type of frequency distribution above noted, may become potentially more dangerous at a considerably higher rate than is indicated by a given proportionate increase in its yearly average bacterial count.

The average percentages of bacterial reduction by the ten plants taken as a group, observed during the year, were: (a) in terms of the 37-deg. count, 95.9 per cent without chlorination and 99.8 per cent with chlorination; (b) in terms of the B. coli index, 99.6 per cent without chlorination and 99.98 per cent with chlorination. Measured in terms of the 37-deg. count, the percentages of bacterial reduction by individual stages of purification (referred in each case to the influent water of a particular stage) were: primary sedimentation, 73.4; coagulation and secondary sedimentation, 74.4; filtration, 85.3; chlorination, 89.7. In general the over-all percentage of bacterial removal tends to increase with the numbers of bacteria in the raw water at a diminishing rate, which becomes asymptotic to a fairly well defined maximum value. This maximum appears to represent the upper limit of purification efficiency attainable with a given process.

The results obtained from daily bacterial tests of the various effluents indicate that with the aid of chlorination a majority of the plants treating Ohio River water are able at present to produce effluents meeting the U. S. Treasury Department (Public Health Service) B. coli standard for a large proportion of the time. The data show clearly, however, that practically all of the plants surveyed are unable to meet this standard without continuous and efficient chlorination of their filter effluents. Of the nine plants reporting results of B. coli determinations on the unchlorinated filter effluent, five reported a yearly average B. coli index greater than 2 per 100 c.c., and seven an average index greater than 1 per 100 cubic centimeter.

From a study of two Ohio River filtration plants made several years ago, evidence had been found that whenever an increase occurs in the bacterial content of the influent water to a purification plant or separate stage of the process, there is a decided tendency toward a corresponding, though not necessarily proportionate, increase in the bacterial content of the effluent. The present study thus far has confirmed this observation in the case of every individual filtration plant in the Ohio River group, indicating that with a progressively increasing bacterial pollution of raw water supplies delivered to plants along the Ohio River, a corresponding deterioration in the quality of their effluents may be expected to occur unless further measures can be taken to increase their purification efficiencies.

As regards the bacterial efficiency of the different types of treatment processes represented in the Ohio River group of plants, the survey has shown clearly the advantage of double coagulation over single coagulation, and likewise of double sedimentation over single sedimentation.

It is concluded that while existing purification systems along the Ohio River are able at present to deliver bacterially satisfactory effluents for a large proportion of the time by resorting to continuous chlorination of their effluents, this last barrier of defense has definitely been reached in the purification of Ohio River water by means now at hand. Since further elaboration of current purification processes would involve costly and, in some cases, virtually impracticable measures, the problem of meeting further encroachments of pollution in this river may call for the consideration of possible remedial measures in the not distant future.

Tree Growth Encroaches on Reservoir

The Krian irrigation reservoir in the state of Perak, British Malaya, had been reduced 20 per cent in area by vegetable growth during the time from completion of the reservoir in 1906 until 1917. F. W. Mager describes the difficulty and a proposed method of dealing with it in a paper recently presented to the Institution of Civil Engineers. The reservoir has an area of 10 sq.mi. and a capacity of about 30,000 acre-ft.; it was built to irrigate an area of 42,000 acres for rice culture. The reservoir area, originally covered with dense, heavy forest, had not been cleared, and after its filling the standing trees died. Fallen trees and undergrowth and subsequent silt deposit formed a good bottom for the growth of aquatic or semi-aquatic plants, and for a second growth of trees. By 1917 the area of the reservoir had been reduced to 8 sq.mi., and the decrease in capacity caused anxiety. Various attempts were made to clear the reservoir, without success. In 1922, when the reservoir ran dry as the result of deficient rainfall, an inspection of its bottom was made. All the stumps of the original trees were still standing, up to water level. As an experiment, a small area was cleared, using hand winches for pulling out the stumps and getting the timber to shore; the cost of this work was $95 per acre. The plan for wholesale clearing which was developed from this inspection involves lowering the water level of the reservoir 4 ft. during eight months of the year, anchoring grubbers to the largest stumps and pulling out all stumps within the radius of the cable, and piling the stumps and logs to form jetties out from the shore line, on which tracks can be laid to transport them to the bank. After the stumps are removed the floating logs can be towed to shore and logs embedded in silt can be washed clear by jets. It is said that continued success of the irrigation enterprise depends on maintaining the full capacity of the reservoir. The project with its associated areas now has nearly 90,000 acres under cultivation and has a present population of about 86,000. Its operation yields a return of 2.9 per cent on the invested capital.

From Job and Office

Hints That Cut Cost and Time For the Contractor and the Engineer

Compressed-Air Plant for Erecting Chicago Trainshed

IN THE erection of the steel framing for the trainshed at the new Union Station, Chicago, all the equipment is operated by compressed air from a central plant having a motor-driven compressor with a capacity of 300 cu.ft. of free air per minute. This plant serves the hoist of a 5-ton traveling derrick and also about six riveting hammers and reamers; the pressure is 115 lb. at the compressor and 110 lb. in the air receiver on the derrick. The maximum length of pipe is 1,200 ft. from the compressor to the tool, including 600 ft. of 3-in. and 300 ft. each of 2- and 1½-in. pipe; in addition there is 100 ft. of ¾-in. air hose. The entire contract involves the erection of about 5,000 tons of steel over an area approximately 1,750 ft. long and 250 ft. wide.

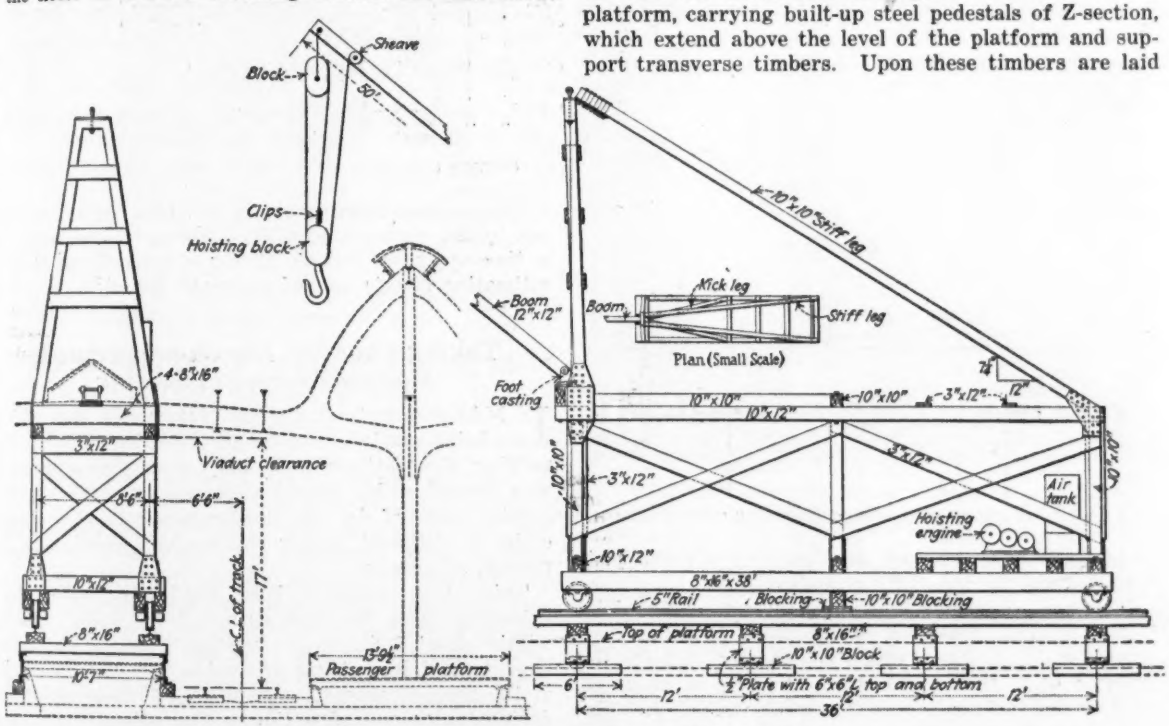


FIG. 1—AIR-OPERATED TRAVELING DERRICK

On account of transverse girders about 16 ft. above the rails, it was necessary to carry the derrick boom above this level in order to get the necessary reach. For this purpose a timber traveler was built, shown in Fig. 1, having an A-frame mast and a 50-ft. boom on the upper deck, giving a working reach of 46 ft. Two stiff-legs support the head of the mast. The heaviest pieces to be handled weigh 3 tons and the hoisting capacity of the derrick is 5 tons. At the rear of the lower deck is a two-drum hoisting engine operated by compressed air from a large tank or receiver and serving the fall rope, the boom swinging line and the topping lift.

The derrick travels over the baggage platforms in the center of each bay (see *Engineering News-Record*, Dec. 6, 1923, p. 928), but as it was specified that its weight should not be carried upon the platforms a special support had to be provided for the derrick track. For this purpose 10x10-in. blocks were laid on the concrete track deck and against the sides of the platform, carrying built-up steel pedestals of Z-section, which extend above the level of the platform and support transverse timbers. Upon these timbers are laid the sills and rails for the double-flanged wheels of the traveler. When at work, the middle of the traveler frame is blocked up on these rails as shown.

On reaching the end of one bay the traveler has to be shifted laterally to the next bay. For this movement four wheels are provided, each carried in a plate frame bolted to the underside of the traveler sills with the wheel at right angles to the traveler track. With the traveler jacked up to bring its regular wheels clear of the rails it is rolled laterally on the transverse wheels to its new position, where it is lowered onto the track. From this new position the traveler must set the last pieces in the roof of the bay it has just left. To provide for this, the boom is unstepped, the foot casting is turned and the boom replaced in a position between the A-frame and the stiff-legs, the boom then being at right angles with the track. This adjustment can be made in a few minutes.

Novel details in the rigging are the use of the fall rope as the hauling line in moving the derrick longi-

tudinally and transversely, and the ease with which the falls can be "singled out" or "reeved up." With ordinary rigging, the combined use of the fall line would require unreeving the cable each time and removing the cable clips, but the derrick is so rigged as to avoid this slow process. From the guide sheave on the boom the fall rope passes down to the gate hoisting block through its single sheave and then over another gate block hung at the head of the boom, from which the rope goes to its attachment to the becket on the hoisting block. When the traveler is to be moved or the falls are to be unreeved the gate blocks are opened and the rope is thrown out, the hoisting block being then carried ahead and hooked to an anchorage. When the move is completed, and it is necessary to "reeve up," the cable is replaced in the sheaves of the gate blocks and the blocks are closed.

A simple traveling platform for the rivet heating forge saves time and trouble in shifting the forge as the traveler advances. This platform, Fig. 2, is mounted on four rollers riding on the longitudinal girders which will form the sides of the smoke ducts in the trainshed roof. There are two 1½-in. pipes for the axles, each carrying two rollers of 6-in. pipe with caps to form flanges. A 2-in. pipe sleeve serves as a spacer. The ends of the 1½-in. pipes pass through

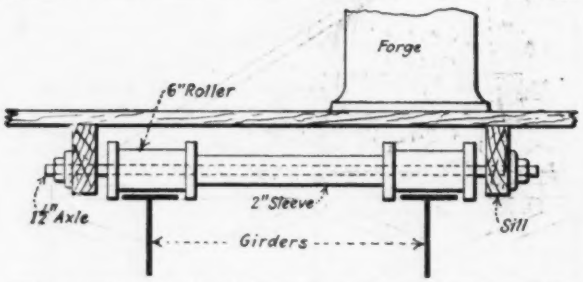


FIG. 2—TRAVELING PLATFORM CARRIES RIVET FORGE

2x4-in. sills across which are laid planks for a platform for the forge and its attendant.

This compressed-air erection plant was designed by W. J. Howard, president of the Kelly-Atkinson Construction Co., Chicago, which has the contract for the erection of the trainshed steel. A crew of about 25 men is employed on each section of the work. J. D'Esposito is chief engineer of the Chicago Union Station Co.

Volumes of Concrete Column Bells

BY R. L. HAWKINS
Estimating Engineer, Aberthaw Co., Boston

IN ESTIMATING flat-slab concrete buildings, it is common practice to consider the concrete in the mushroom head, or bell, as a separate item, the shaft being taken off as a simple cylinder extending from floor to ceiling. Since it is also common practice to design concrete columns with a bell of 5 ft. maximum diameter regardless of diameter of column shaft, there is obviously a variation in the volume of concrete in the bells for columns of different diameter.

In a small structure, this may be assumed without materially affecting the estimate. However, in a large, multi-story structure, having a large number of columns varying in size in different stories, the volume of concrete in bells is sufficient to warrant careful estimating.

From Job and Office

Hints that Cut Cost and Time

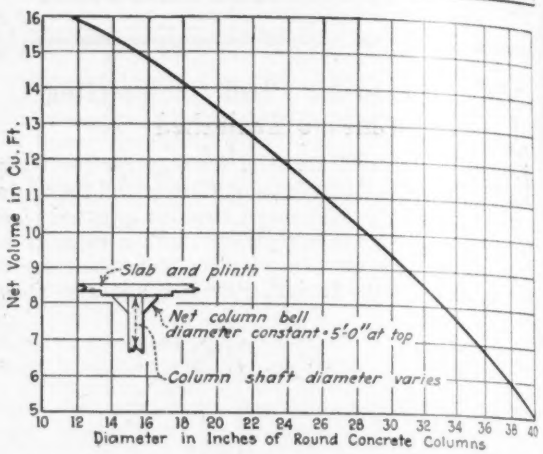


CHART GIVES VOLUME OF ROUND COLUMN BELLS

The accompanying chart is one of a series worked out by the writer to simplify estimating and has been a time-saver as well as having eliminated inaccurate estimating of this part of a concrete building.

Taking Concrete Dam Temperatures During Process of Setting

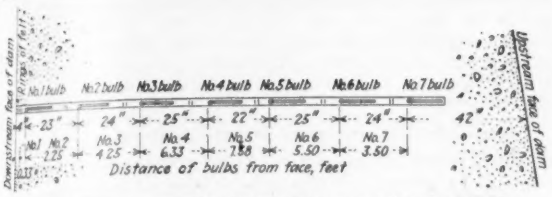
IN MAKING tests on the Emigrant Creek dam which are being carried on under the direction of the Engineering Foundation's arch dam committee, a scheme was devised which proved to be a convenient and accurate means of determining temperatures of the concrete at different points while the cement was in process of setting.

This scheme called for holes about 2 in. in diameter, extending from the downstream face of the dam to within about 3 ft. of the upstream face. The holes were formed by putting greased pipes in the concrete at the time of pouring and turning them occasionally during the process of setting so that after the concrete had taken its set the pipes could be easily withdrawn. The pipes used had an outside diameter of 2⅜ in. and before being put in the dam were straightened and turned in a lathe. A wooden rod of somewhat smaller diameter was then prepared for each hole, the length being such that in each case the rod projected slightly from the downstream face of the dam. The lowest rod, inserted at a point where the dam is 15½ ft. thick, had seven thermometers embedded in it, the middle rod, where the thickness is 10½ ft., carried five thermometers, and three were used on the upper rod where the thickness is 5½ ft. The thermometers used were of the type using a marker to indicate maximum readings and each thermometer was separated from the one adjoining by several felt washers which completely closed the hole and prevented movement of air along the rod.

With this arrangement the marker in each thermometer was set at some point below outside air temperatures and the rods were then thrust into the holes. After 24 hours and during the cooler time of day the rods were withdrawn and the maximum temperatures

From Job and Office

For Contractor and Engineer



LOCATION OF THERMOMETERS ON WOODEN ROD IN THE DAM

recorded. When setting was progressing most rapidly temperatures as high as 132 deg. F. were reached and the readings were made daily. Later, when the temperatures were gradually falling off readings once a week were considered sufficient.

The advantage of this system as compared to the usual thermo-couple or thermometer embedded in the concrete is that the instruments can be inspected, checked up or replaced as often as may be necessary. The equipment required is very simple and the readings do not require an observer with special training or unusual skill.

The scheme was devised by D. C. Henny, consulting engineer of Portland, Ore.

White Brick Form Permanent Center Line in Ohio County Road

By C. L. Sawyer
Surveyor of Lucas County, Toledo, Ohio

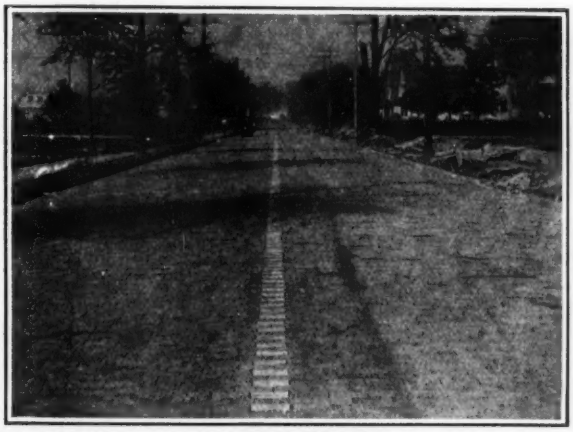
THE EVER increasing automobile traffic makes it imperative that county as well as city authorities take definite steps to insure safety of travel on the highways. The easiest and apparently surest method is to mark travel lanes on important thoroughfares. In the past we have done much by painting lines and warnings at curves and dangerous places; however these are quickly obliterated and often before they dry. Also, the cost of maintenance is considerable. With the idea of permanency in mind a recent improvement in our county of approximately two miles of 36-ft. brick pavement offered us a chance to experiment with traffic marks of a more substantial nature.

Our first thought was to lay a continuous line of white brick down the center of the road and pave either way from them. This was discarded because it would have called for use of half brick or bats in the center of the pavement, a practice considered neither good construction nor desirable from a maintenance standpoint. It would also have required two men to lay the brick away from the center line at the same time, and we found it impossible to maintain a straight line of brick across the road inasmuch as no two men lay with the same accuracy. A survey of a number of brick pavements in the vicinity of Toledo indicated that if every other brick were used a rather creditable straight line could be drawn with only slight readjusting. Work was therefore started on that basis, allowing the actual laying of brick to continue as theretofore.

Two men followed back of the regular laying crew measuring out from the curb to the nearest edge of a true line of center brick; inserting a white one in the place of the regular brick and adjusting that line so that it met the chalk line. Care was used to place the white brick in the row that was started with the half brick, so that in adjusting either way all that was necessary was either to cut down the size of the bat or insert a larger one, gathering up the misfits and using them ahead.

This method is simple and entails but slight confusion as the two men behind the regular laying crew keep up with the natural progress and do all of their adjusting before the initial rolling. A small quantity of oil was brushed on the white brick to keep the filler from adhering too strongly. The white traffic line of course will not be apparent until the filler has worn off so that the bare brick are exposed.

Using 4-in. brick this method requires 7,800 white brick per mile. They were secured from the Globe



PERMANENT CENTER LINE MADE OF WHITE BRICK
A warning sign "SLO" may also be seen at the left. This sign was laid up in white brick, making a permanent crossing warning.

Brick Co., East Liverpool, Ohio, at a cost of $4 per thousand more than the regular paving brick. The laying crew averaged, under ordinary conditions, 300 ft. per day, which would make 18 working days per mile. The wages of the two extra men at $4 per day for that length of time amounted to $144. A small sum in excess of these two amounts must be added for extra brick that are required to make the extra bats in the rows of brick that have been adjusted, so an amount of $185 per mile is the cost of the white line of brick.

We later experimented further and at prominent intersections inserted the word "SLO" about 100 ft. back of the crossing. Also, the words "OTTAWA PARK" were placed at the entrance to one of the county's public parks.

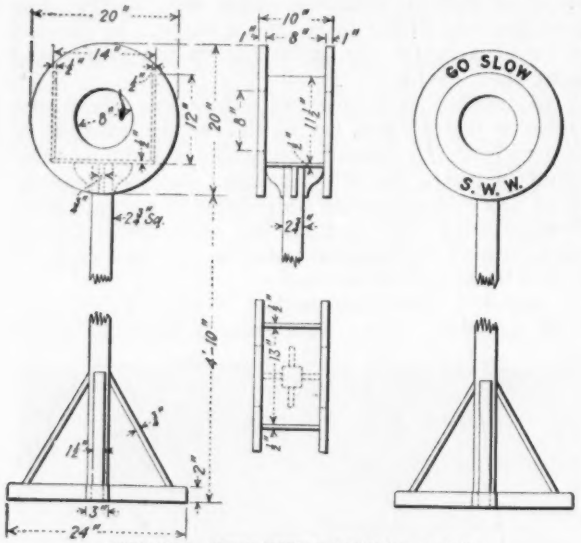
Safety Standard for Warning Lamp

By W. W. Monks
Foreman Pipelayer, Shanghai Waterworks Co., Shanghai, China

MOST municipal engineers and water-works superintendents have had at some time difficulty in keeping danger lamps lighted during strong winds and stormy weather. With some study the writer devised a standard and lamp which will withstand the most severe weather.

A red lamp is placed in the slot at the back of the warning post shown herewith, care being taken that the glass of the lamp is not placed too near the hole (a

space of about 1 in. should be enough) so as to allow a small circulation of air. The warning standard should be made to suit the lamps which are to be used. One of these standards can be made from ¼-in. steel



DETAILS OF SAFETY SIGNAL LAMP

sheeting. The slot at the back should be welded on to the face and a piece of 1½-in. old galvanized iron pipe will act as the center post and 1-in. old gas pipe as the four legs. The cost is very little. The dimensions here given apply for a special make of lamps.

In addition to being a lamp standard it acts as a warning post during the day; at night it is visible at a considerable distance.

Contractor Standardizes Canvas Cover for Winter Concreting

THE EXTENT to which winter construction is carried on is not readily realized until one discovers the fact that in a single year the Turner Construction Co. purchased new canvas covers to the value of $30,000, to be used for protecting buildings under construction during the winter months.

These covers are purchased early in the fall and stored in the Turner yard until required by various jobs. The reasons for early purchasing and storing in the yards are that the covers can generally be purchased cheaper at that time, that they can be carefully checked as to size, material and workmanship, and that they can be delivered to jobs without delay when required if they are in stock. In the accompanying drawing is shown a detail of one of the Turner winter weather canvas covers. The covers are purchased according to the following specifications:

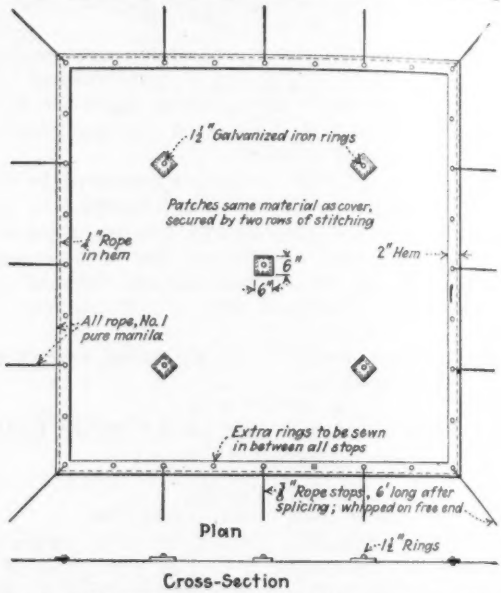
Covers to be made of 12-oz. U. S. standard army duck 28½ in. wide. Covers to be 20 ft. x 20 ft. finished size and must measure full size without stretching upon delivery. All sewing to be two-row lock stitched with 6 stitches of 5-cord Weetamoe soft finish thread or heavier per inch. Seams to be at least 1 in. wide. A 2-in. hem is to be sewn over a ¼-in. pure manila rope all around the four sides of the cover. Each cover to be provided with a ¾-in. rope stop 6 ft. long after splicing at each corner and to have three additional stops on each side between corner stops. All stops to be whipped on the free end and to be spliced through a sewn-in ring. Place extra sewn-in rings in the hem midway between the above stops. All covers to be made with five 6-ft. square patches sewed on to one side

From Job and Office

Hints that Cut Cost and Time

of the cover. One of these patches will be placed in the middle of the cover and the other four patches will be placed, one each midway between the center patch and each corner of the cover. To each of these patches is to be securely sewn a 1½-in. galvanized iron ring. Each cover will be stenciled.

These specifications were adopted, says a recent issue of the *Turner Constructor*, after considerable experimenting to determine the proper size of cover, weight


1½" Galvanized iron rings
Patches same material as cover, secured by two rows of stitching
¼" Rope in hem
2" Hem
6"
6"
All rope, No. 1 pure manila
Extra rings to be sewn in between all stops
¾" Rope stops, 6' long after splicing; whipped on free end
Plan
1½" Rings
Cross-Section

DETAILS OF CANVAS COVER FOR WINTER WORK

of duck to be used, necessary ropes, rings for fastening and possibility of waterproofing so that the covers could be used for rain protection the following summer.

Pin-Connected Pipe Forms Structural Elements for Small Building

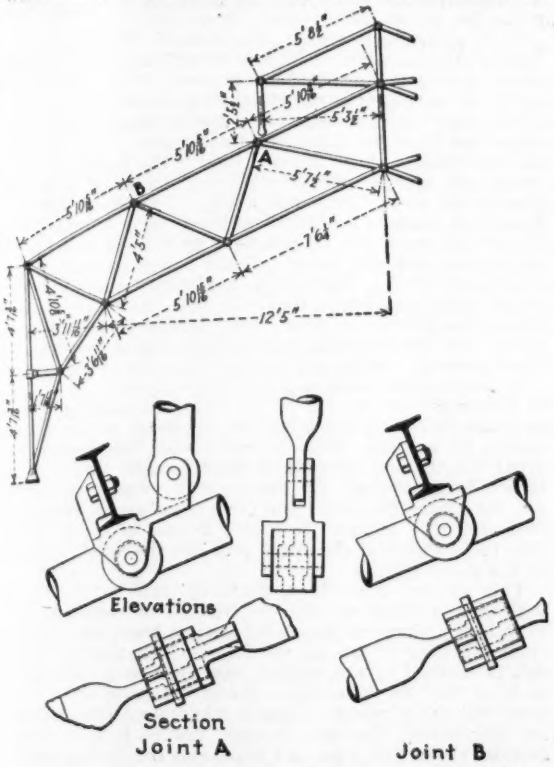
OXWELDED pipe has been used a number of times in the United States in building construction. In a recent issue of *Engineering* there is given an article on the construction of a shed in the Hague, Netherlands, in which pipe of varying diameters flattened and reamed for bolt holes formed with their pin connections the structural elements. In the particular building described the upright pipe is 3 in. and 4 in. in diameter, the rafters and tiebars are 2½-in. pipe and the diagonal members of the roof trusses are made of 2-in. diameter pipe. The structure has a span of 32 ft. 9½ in. and a length of 82 ft. 2½ in. Trusses are made up completely of triangles composed of short lengths of pipe provided with flat ends connected to each other by pin points.

For the construction of the components of each truss, pipes were cut to lengths required and then plugs of steel were inserted in the ends. The protruding plugs in the ends of the tubes were heated until white hot and then pressed into complete union with the pipe; the ends of the plugs were pressed into flat disks at the same time. With this operation completed, bolt holes

From Job and Office

For Contractor and Engineer

were drilled and the depressions or projections were machined around the bolt holes to obtain good bearing between the parts when they were later assembled. Where the purlins cross the upper chord of the truss,



DETAILS OF PIN-CONNECTED PIPE TRUSS

brackets of special form were necessary. For Position A in the figure the bracket which is used for the support of the purlin is extended to provide a pin joint to the vertical member of the monitor frame.

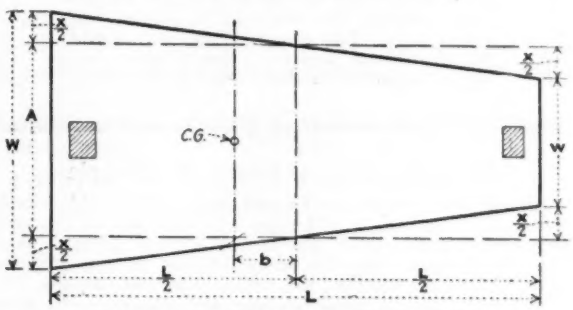
The advantages claimed for this method of building structures include equal strength to roll section construction with less weight of material; components are comparatively cheap and assembly easy and inexpensive; and field assembly is simple, making transport of materials more easy.

Determining End Widths of Trapezoidal Combination Footings

By A. E. Cooper
With Harkness, London & Hertzberg, Consulting Engineers, Toronto, Ontario

Having occasion to design some trapezoidal combination footings and feeling that there ought to be some simpler method than is usually given in textbooks, the writer devised the following:

After the usual routine of finding the center of gravity of the loads, the area required for the footing, the length of the footing L to meet limitations of lot lines, etc., the average width of the footing A and the distance from the center of gravity required to the



SECTION OF TRAPEZOIDAL FOOTING

center of the length of the footing b, the troublesome step is to find the increase or decrease in the width, over or under the average width to give the footing the correct center of gravity or pressure. This increase or decrease in width we will call x, the width at narrow end w and width at wide end W.

Taking moments about the narrow end of the footing:

$$\frac{(A-x)L^2}{2}+\frac{2xL^2}{3}=LA\left(\frac{L}{2}+b\right)$$

$$\frac{(A-x)L}{2}+\frac{2xL}{3}=A\left(\frac{L}{2}+b\right)$$

$$\frac{AL}{2}-\frac{xL}{2}+\frac{2xL}{3}=\frac{AL}{2}+Ab$$

$$\frac{xL}{6}=Ab$$

$$x=\frac{6Ab}{L}$$

$$w=A-x \text{ and } W=A+x$$

Job and Office Notes

In Its Manual of Standard Signs and markers the Division of Highways of the state of Ohio describes a guard for placement over newly-painted traffic line strips. The paint band which usually is about 4 in. wide is spanned by a 2 x 6 x 10-in. block with feet 1 x 2 x 6 in. on either end to raise it from the pavement surface sufficiently so that no part of it touches the newly-applied paint. In the center of the block is placed a 2-ft. rod to which is attached a red flag. These blocks are usually placed about 30 ft. apart so that traffic is kept away from the newly-painted strip.

A Novel and Interesting Method of excavating a pipe trench in locations where the ground-water is near the surface was devised by the plant engineer of the Standard Steel Car Co., Hammond, Ind., where an extensive fire-protective system is being installed. The soil consists of sand with the ground water level 3 ft. below the surface. Excavation for the fire mains in the wet, sandy soil by ordinary methods would be expensive and troublesome, requiring braced sheeting and constant pumping. The method used was to drive down well-points about 6 ft. apart along one side of the trench and slightly below the bottom. Parallel to these was laid a 4-in. pipe-header to which the tops of the well-points were connected by short pieces of rubber hose. A 7-in. x 10-in. triplex pump, motor driven, takes suction from the 4-in. line and is able to keep 400 ft. of the trench entirely dry, enabling several gangs of men to work at a time without the use of sheeting or bracing.—*Factory Mutual Record.*

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

In Appreciation of George C. Whipple

Sir—It still hardly seems possible that our old friend, George C. Whipple, is no longer with us. He was so uniformly happy and busy that it was a great shock to hear of his sudden passing. He seemed to me like one of those beautifully built watches which are good for all time.

It was my good fortune to know him well from the days when he was in charge of the laboratory of the Boston water-works under Desmond FitzGerald, and he had two characteristics which impressed themselves on me more and more as the days of our acquaintance lengthened.

Nobody I have known was more imbued with a determination to get to the bottom of the subjects taken up. And as these subjects were always quite novel in his case, what he had to say about them was worth listening to, and easy to follow, moreover, because be combined with his scholarly thoroughness an unusual happy manner of talking and writing clearly yet accurately. His studies of plankton were pioneer work in this line in the United States, yet his "Microscopy of Drinking Water" is one of those books it is a real pleasure to read because of the clearness with which everything is stated. It is too often the case that pioneer work is described with such a profusion of new scientific terms that it is needlessly difficult to find out what the author means.

Every time I saw him he was delving to the bottom of some subject, often an old one, yet one he would leave illuminated in a new way, making it easier for all to understand. The study of mathematical statistics which he made in order to bring out more clearly certain features in public health work, embodied in a paper on the latter subject, is frequently quoted now in works on statistical methods. This mathematical study, which is certainly far removed from the microscopy of water, was characteristic of his determination to be thorough, a determination which found expression in the remarkable educational course he built up at Harvard, placing sanitation on a basis of sound science and practical efficiency.

The second characteristic I learned to love in him was his ability to say "No" to those who asked his aid in perfectly good undertakings. He realized that he could do just so much in a day and he proposed to get the most good from each day. Nobody can do that and undertake to do a large number of things, but most of us like to be counted among the helpers in good causes, so we promise more than we can do. Whipple never did, and so he was able to accomplish a great deal of good for engineering, for hygiene and for good citizenship generally, by saving the many moments most of us waste in half fulfilling hasty promises.

Whipple accomplished a great deal by making practically available many of the ideas which Sedgwick left as objects to be desired if they could be carried out. My feeling has always been that Whipple was one of the really great scientific engineers of our time. JOHN M. GOODELL.

New York City, Dec. 1.

Control of Storm-Water Flow to Sewers in the City of The Hague, Holland

Sir—In replying to the remark, made in an editorial tail note to my letter in *Engineering News-Record*, Oct. 30, p. 722, I want to state in the first place that the relative situation of land and water in Holland is entirely different from that in the United States; therefore the way in which the flow of the water has to be regulated is also different, and the sewerage problem has to be treated in quite a different way. In the United States a town is, generally speaking, situated in the valley of a beck or river, or it lies on a gently slope, at the coast of an ocean or of a lake. The level of subterranean water is lower than it is in Holland; the level of the water in rivers and in the ocean is subject to considerable variation.

In Holland the chief characteristic of the country from the standpoint of the civil engineer, who has to regulate the flow of the water, is the "polder" system, large parts of the country being below sea-level, so that the water has to be pumped up into open water; this is done by means of canals, which are called "bosoms" ("boezem" in Dutch). These bosoms are hemmed in on both sides, by dams. The height of the water level is almost perfectly constant; it does not vary more than 16 in. in a year; and the level of the subterranean water is high, often no more than 20 in. under the street—rarely more than 4 feet.

With regard to sewerage, this state of affairs has the following consequences. In the United States and elsewhere, where towns are situated on a slope, it is necessary to carry off not only the rainwater which falls on the surface of the town itself, but also the water flowing down from the higher parts of the slope. We rarely find places where we can construct a storm sewer. This is the reason why in a "combined system" we should want sewers of such huge dimensions as to "bankrupt a city." In these difficulties European engineers help themselves (and in the United States this must also be possible) by making reservoirs in connection with the sewer. These reservoirs may be constructed in parks, where they need not impair the beauty of the town, and where they may take the shape of ponds. These reservoirs are filled, only during a few hours in every year, with sewage considerably diluted by rainwater. They prevent damage and diminish the size of the sewer.

In Holland the problem is entirely different. Every town is penetrated by several of the canals already mentioned in connection with which we can construct as many storm sewers as we like. These storm sewers need never be of great length, and because of their number they need not have a large section. All the water is pumped up into the sea, both from the sewer and from these canals, each by its own system of pumps. It is only in case of heavy rainfall that the overflow of the sewer gets into the canals by means of the storm sewers.

This system deals in a perfectly satisfactory manner with all the water we ever get, though we sometimes have very heavy showers, up to 2.2 in. per hour, with a maximum intensity of 5.5 in. per hour. This satisfactory result is reached by the method, described on p. 722 of your issue of Oct. 30. To enable the street sewer to contain a great volume of water, it has a minimum section of 16x24 in., eggshaped; the very largest sewers have a cunette-section, about 9 ft. high and wide, and the "rising main" is of a circular section, 7 ft. in diameter.

About 40 storm sewers serve to give the sewage an opportunity of flowing into the canals in case of very heavy rainfall, when all the pumps are also working. The dimensions of the storm sewers vary from 2 to 5 ft., circular section. The surface covered by the town of The Hague itself is 4,500 acres, with 90 inhabitants per acre.

By the use of this trustworthy method we are able to prevent all damage and to reduce expenses to within reasonable limits.

It seems to me that in those parts of the United States which are low, compared with the subterranean water level, and which are therefore comparable, in this respect to Holland, the same system could be applied to great advantage. I believe that this might be the case in the so-called "New Jersey Meadows." I think a scheme devised by a Dutch engineer with sufficient experience on this subject would be extremely helpful in converting these "meadows" into suitable building grounds.

F. C. J. VAN DEN STEEN VAN OMMEREN,
Sub-Director of Town Works.

The Hague,
Nov. 20, 1924.

Railway Electrification in England

The London Midland and Scottish Ry. is to electrify part of its line in the neighborhood of Manchester, the great industrial center, where there is considerable freight as well as heavy passenger traffic. In all, about 12 miles will be electrified at an estimated cost of £600,000. Freight yards will be electrified, the third-rail system installed, and new stations built.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

News Brevities

Additional Contracts for Bridges and grading have been let by the Illinois Central Ry. for work on the new line which the railway is building through southern Illinois into Kentucky.

Membership in the Am. Soc. C. E. now amounts to 11,364, divided as follows: Members, 4,961; associate members, 5,510; honorary members, 13; juniors, 725; affiliates, 167; and fellows, 8.

The President Has Nominated for promotion to the rank of lieutenant-colonel the following majors of the Corps of Engineers: Warren T. Hannum, Robert R. Ralston, Mark Brooke, Laurence V. Frazier, James Franklin Bell, Gilbert H. Stewart.

An Explosion Which Killed one man and injured others occurred at Elevator B operated by the Montreal Harbor Commission on Dec. 1. The explosion, believed to have been due to igniting of grain dust, caused a fire resulting in a loss of $50,000 in property. Harbor engineers are investigating the cause of the explosion.

Construction of an Interprovincial Bridge between the provinces of Quebec and New Brunswick, on the Restigouche River at the northwest end of Chaleur Bay, has become a necessity, according to the board of trade of Campbellton, New Brunswick, which has asked the premiers of both provinces to visit the region next spring. For some time efforts have been made to obtain the construction of this bridge, which would cost approximately $1,000,000.

A Boston Chapter of the Associated General Contractors of America is to be organized as the result of a conference in Boston, Nov. 12, between F. L. Cranford, president, and Gen. R. C. Marshall, Jr., general manager of the A.G.C., and 20 general contractors of the New England metropolis. H. L. Rogers, of Stone & Webster, is chairman of an organization committee which was named by the Boston contractors to perfect the chapter.

In Order to Increase the revenue at their disposal for highway construction and maintenance, the Ontario government announces that it will present to the legislature a measure imposing a tax on gasoline. The amount has not been definitely determined but an impost of 2c. per gallon is proposed, which it is estimated would produce a revenue of about $1,000,000. The tax is intended to apply to motorists only and farmers and manufacturers using gasoline for other purposes will be given a rebate.

Delaware River Commission Agrees on Tentative Plan

The Tri-State Delaware River Commission, created in 1922 by the state legislatures of New York, New Jersey and Pennsylvania, has agreed on a tentative draft of a treaty to govern the division of the flow of the Delaware River between the three states named. After providing for the maintenance of a minimum stream flow, the rights of diversion above Port Jervis would be held equally by each state while below that point, which is where the boundaries of the three states meet, Pennsylvania and New Jersey would share half and half. The report of the commission will be submitted to the three legislatures when they meet next year.

San Diego Votes Bonds for El Capitan Dam

At a municipal election on Nov. 18 San Diego voted by a majority of more than three to one the $4,500,000 bond issue for the construction of El Capitan dam on the San Diego River, a water-storage project.

The election closed a hotly-contested campaign by two factions, favoring El Capitan and Mission Gorge dam sites, respectively. M. M. O'Shaughnessy as consulting engineer urged the construction of El Capitan dam, stating that it would produce the greater quantity of water and that this development in connection with the proposed San Vicente dam would yield the city a gravity supply totaling 20 m.g.d. and that the unit cost for this supply would be "the lowest that it is possible to obtain."

Recommend More Engineers For Naval Corps

Filling 14 vacancies in the Civil Engineers Corps of the United States Navy is the principal recommendation contained in the annual report of the fiscal year of 1924 made by Rear-Admiral L. E. Gregory, chief of the Bureau of Yards and Docks. According to Admiral Gregory's report on September 1, 1922, the corps consisted of 104 regular officers excluding two carried as extra members, and in the following year 98 regular officers, excluding one extra. At the present time the corps carries 96, having lost 8 officers from its personnel. No appointments have been made since September, 1921, and although four ensigns have been assigned, their services will not be available until June, 1927. Relief must be had through making appointments. Recommendation is also made by Admiral Gregory that expansion in the corps be allowed by Congress.

Deficiency Bill, Passed, Carries Reclamation Appropriations

The deficiency bill which failed of passage at the last session of Congress when the Senate declined to yield to the demand of Senator Pittman of Nevada that it carry an appropriation for the Spanish Springs reclamation project, was passed promptly at the opening of the present session. Senator Pittman withdrew his objection when he learned that the appropriation is provided for in the new budget.

The deficiency bill then was sent to the White House and was signed by the President on Dec. 5. The measure provides appropriations which include the following: for an engineering survey as to the possibilities of additional storage, Carlsbad project; $50,000; Colorado river levees and front work, Yuma project, $200,000; for construction and continuance of investigations Kittitas unit, Yakima project, $375,000; Owyhee project, Oregon, construction and incidental operations, $315,000; Salt Lake Basin project, continuation of construction, investigation and operations, $375,000; commencement of construction, Guernsey reservoir, $800,000; co-operative investigations, $125,000.

The House insisted on a provision to which the Senate conferees agreed, which provides "that no part of the sums herein appropriated shall be used for the commencement of construction work on any reclamation project which has not been recommended by the Commissioner of Reclamation and the Secretary of the Interior and approved by the President as to its agricultural and engineering feasibility and the reasonableness of its estimated construction costs."

The paragraph in the bill providing for the salary of the commissioner at a higher rate than that now authorized was struck out on the understanding that this would be provided in a separate bill.

The measure also provides for some, but not all, of the recommendations of the Fact-Finding Commission.

Establish Highway Fellowship

The United Fuel and Supply Co. of Detroit, Michigan, has recently established a fellowship in highway engineering to be devoted to investigations under the direction of the division of highway engineering and highway transport of the University of Michigan covering advisable methods of sampling and testing sand and gravel to be used in connection with highway improvement. The United Fuel and Supply Co. fellow will make an extensive investigation of plant production of sand and gravel prior to determining efficient methods of sampling.

U. S. Commerce Commission Reviews Railway Situation

Heavier Rolling Stock Offsets Disadvantage of Lack of Adequate New Construction

Outstanding facts in the railroad situation, as presented by the Interstate Commerce Commission in its annual report, are that the continued substitution of more powerful locomotives and larger cars for the older equipment has in a measure offset the disadvantage to the country of the lack of adequate new construction. Combined with increased operating efficiency the factors have resulted in carrying the country through a period of record freight movement without much congestion and with no such car shortage as the country frequently has experienced in the past. This improved condition has been augmented by increased co-operation between the shippers and the railroads through the medium of the Regional Advisory Boards instituted by the car service division of the American Railway Association. Ten of these boards have been authorized and are now functioning. They have done much to speed up car loading and to eliminate much of the friction which heretofore existed between the railroads and the shippers.

Freight Rates—No general freight rate reductions throughout the country have been made during the year, but the process of readjustment and reduction of individual rates has been continued. The commission says that it does not think it advisable to undertake any general investigation of all rates, but thinks that a readjustment of the rate structure to eliminate maladjustment is necessary; that progress toward standardization of rates could better be brought about through individual cases and investigations dealing with particular rate territories.

The slackening of business in 1924 reduced the gross earnings of Class I railways during the first eight months of the year by nearly $338,000,000 dollars, or about 8 per cent below those for the same period in 1923. In short, the net earnings, although better than those in 1921 and 1922 are not as good as in 1923. The commission states that the return of 5¾ per cent upon fair value is not being received by the carriers, and that it is well to note in this connection that net railway operating income takes no account of non-operating income nor of interest charges. When these and related items are taken into account, the result is called in the commission's official report "net income." For roads of Class I, II and III, excluding switching and terminal companies, the net income for 1923 amounted to 7.06 per cent of the capital stock.

Of the carriers reporting excess income, 53 have paid into the commission during the year $4,858,000. The majority of the payments have been made under formal protest, and, therefore, the contingent fund has not been made available for use as contemplated by the statute.

Valuation—The commission estimates that there will be about 500 hearings on protests to tentative valuations. So far, 24 final valuations have been promulgated, covering only 4,396 miles or 1.8 per cent of the aggregate, and the commission calls attention to the disadvantage of the delay of the protracted valuation proceedings to the general railway situation.

Log Water Pipe Dug Up in Seattle

A section of log water pipe representing the first water system in Seattle, and laid in 1874 by Henry L.

Yesler, a Seattle pioneer, was recently unearthed. The 10-in. fir log with a 2-in. bore was laid in 6-ft. lengths. Pipe is to be placed in the museum of the Chamber of Commerce.

Relief Offered Settlers From Reclamation Payments

Notice has been issued by the Bureau of Reclamation that applications for relief from payment of charges will be received until Jan. 1, under Sec. 2 of the Relief Act passed May 9, 1924. Under this section the Secretary of the Interior is authorized, prior to March 1, 1925, to add accrued and unpaid charges to the construction charge of the land, and to distribute the accumulated charges either equally over the remaining years of the 20-year payment period or unequally in such manner that one-fourth of the charges will be distributed over the first half of the remaining years of the period and three-fourths over the second half of the period. Penalties or interest previously accrued are canceled when such adjustment is made, but the extended payment draws interest at the rate of 5 per cent.

This relief is available to individual farmers or to districts or water users' associations. It is in each case dependent upon satisfactory showing being made of inability to pay the charges, but is applicable both to construction and to operation and maintenance charges.

Orders have been issued by Dr. Elwood Mead, Commissioner of Reclamation, that all applications under this act are to be passed upon by the project chief clerks and the director of finance as rapidly as possible, in order to assure action by the commissioner and the Secretary of the Interior within the time limit fixed in the law. Applications need not be made on any prescribed form.

New Safeguards Sought for Reclamation Projects

Deficiency Bill Discussion Elicits View New Projects Must Wait Development of the Old

Washington Correspondence

While the appropriations committee of the House cannot initiate reclamation legislation, through its control of the purse strings it is in a position to force consideration, at least, of new policies in the handling of these projects. The appropriations committee is not in full sympathy with new projects which the deficiency bill first carried. It is felt new basic policies are about to be worked out for the handling of reclamation and that in the meantime no new project should be started. The committee, however, was not in a position to eliminate those projects from the deficiency bill so an attempt was made to surround them with new safeguards.

In line with editorial suggestions in *Engineering News-Record* it is stipulated that no part of the appropriation may be used for construction purposes until contracts are made with irrigation districts, organized under state law. The construction costs are to be charged against each district and are to be payable in annual installments. In the case of the Salt Lake Basin project the first installment is to be 5 per cent of the total charge to be paid Dec. 1 of the year following the date of the public notice announcing the availability of water. The remainder of the construction charge, with interest on deferred amounts, from the date of the public notice, at 4 per cent is to be amortized by payment on each Dec. 1 thereafter of 5 per cent of the remainder for forty years. Operation and maintenance charges are to be paid annually in advance, not later than March 1.

Need for Business Methods

Representative Cramton of Michigan, who is taking the lead in this matter, emphasized the fact that the administration and the Congress believe in reclamation, but he declared it is absolutely necessary to put this work on a better business basis. "It must be taken out of politics," Mr. Cramton declared on the floor of the House. "Projects must be selected not through political logrolling, but upon the basis of merit and with reference to opportunity there is for each project to succeed and make good, but there never was a time when we were more at sea as to what is going to happen in reclamation than now." He pointed out that $150,000,000 have been spent but only $18,000,000 have come back.

Mr. Cramton further pointed out that the state of Washington has enacted a land-settlement law to aid in the development of the state and the proper settlement of the land. It provides a fund to be used for loans to settlers. He urged co-operation between the United States and the separate states under which the federal government would build the works, bring the water to the land, and then deal with a reclamation district.

A.A.E. Secures Low-Premium Insurance for Members

The American Association of Engineers has completed arrangements for providing legal reserve insurance service to the members through the Liberty Life Insurance Co. of Kansas, with offices at Topeka. The contract dated Nov. 8, 1924, provides accidents and health insurance as well as life insurance for the individual members at practically net cost.

The accident and health policy is of the non pro-rated, non-classified type. The same rate is charged for all members, no matter what their occupation may be. Any member normally occupied at a desk may inspect construction work or perform any engineering duties in the field without impairing the value of his policy.

In the association policy, a rate has been figured out for all engineers of whatever branch and however employed in professional engineering work. For coverage of $100 per month, the usual rate in three other companies issuing this broad form of policy is $64 per year. A member of the American Association of Engineers obtains the same coverage for $41.50 the first year and $38.50 each year thereafter.

The saving in the life policy cannot be stated with accuracy until after experience with the engineering group. It is felt that it will be considerable because of the high class of risk which engineers represent. The life policies are written on a net cost and in addition, there will be returned to the insured member one-half of the mortality savings for the group. It is expected that the net savings on life policies will amount to the annual dues on each $5,000 policy.

Life policies will be issued in two forms, whole or straight life and twenty-year payment. Companies writing net cost insurance are usually, non-participating. American Association of Engineers policy is net cost and participates in the mortality savings.

There is also a term or student policy for ages from 15 to 25 years to enable the engineering student to insure or underwrite at a low rate and providing his transfer to the ordinary life or twenty payment life after leaving college.

City to Bid Against Contractors on Minneapolis Auditorium

After months of contention for building the new $3,000,000 municipal auditorium by day labor, the city council of Minneapolis has decided to invite bids for the work from contractors and in effect, from the city engineer as well, the job to be divided into three parts: Excavation; reinforced concrete, other masonry and carpenter work; and structural steel and iron work. If the city engineer's estimates are lower than the bids from contractors the city will do the work. The council voted to notify bidders that common laborers on the job must be paid the city rate of 62½c. an hour, which is 7c. above the prevailing rate for union labor in the city of Minneapolis.

Congressman Praises Weymouth for Reclamation Work

Release of the record compiled during the appropriations committee's hearing on the Interior Department appropriation bill reveals the fact that Representative Cramton, the chairman of the sub-committee, paid the following tribute to F. E. Weymouth, who recently resigned as chief engineer of the Bureau of Reclamation.

"I think it is only a fair tribute to a man who has rendered a very distinguished public service for me to take this occasion to say that I think Mr. Weymouth deserves well of the esteem of the country. I have come in contact with him on this committee, and I have come in contact with him in the field; I have seen his attitude in the matter of presentation of the matters to the public, and I have seen the Arrowrock Reservoir, and I think it is only proper that I should record here my very high opinion of his work for the Government and I personally regret that for any reason he has felt it desirable to leave the service."

Western Reforestation Studied

The first attempt on a large scale to solve the reforestation problem in the Pacific Northwest is to be made by the Weyerhauser Timber Co., George S. Long, general manager, announces. The Weyerhauser Logged-Off Land Co., organized with a capital stock of $1,000,000, will take over all the cut-over timber lands held by the Weyerhauser interests in the state of Wasnington, and a scientific survey of these lands, which include more than 150,000 acres, will be made.

The lands will be classified according to their value for agricultural or grazing purposes, and for the growing of a second crop of timber. The articles of incorporation give the new company the right to acquire logged-off lands, engage in reforestation, clear land, maintain and manage farms, engage in all forms of agriculture and stock-raising, and conduct experimental and research work in agriculture and reforestation. The stock of the company will be held by the Weyerhauser interests, and the work planned is largely experimental.

New Bids on American Falls Dam to Be Called For

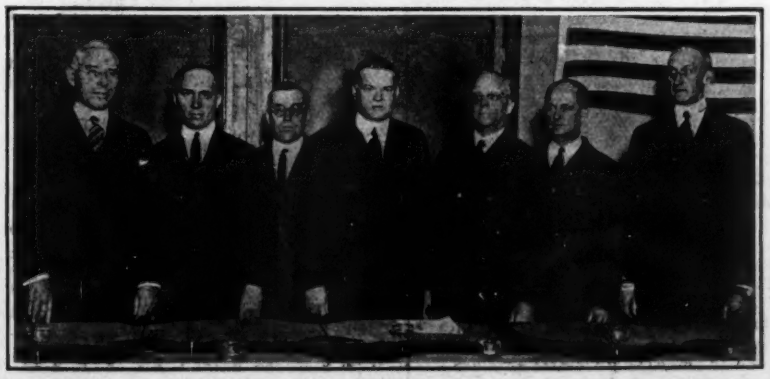
It is probable that new bids on the American Falls dam will be asked shortly. This proposal will be for a complete dam, the height of the dam (whether for the larger or the smaller capacity) not to be fixed until after the foundation is in, however.

According to facts learned from the officials of the Bureau of Reclamation, after the bids received Oct. 20 (only two bids were received, of which one was low for the low dam and the other was low for the high dam) were rejected, urgent demands came from the irrigators to get construction started so that no time would be lost. In response to this demand plans were prepared for a foundation in the river section, this foundation being capable of receiving either the large or the small superstructure. Bids on the construction of this foundation were called for Dec. 20, but shortly after issuance of the call were postponed by formal notice. The postponement resulted from the fact that heavy snowfall in the mountains indicated that there would be no shortage next year, so that pressure from the irrigators to hurry the construction disappeared, thus allowing the Bureau more time to prepare for contracting for the entire dam.

Testing Materials Meeting Set

The American Society for Testing Materials announces that the annual meeting of the society next year will be held at the Chalfonte-Haddon Hall, Atlantic City, N. J., June 22-26. The executive committee reports that it had considered the suggestion made by a member of the society and endorsed by one of the committee that the annual meeting be held in the fall of the year instead of June. After reviewing the arguments for and against the proposal, the executive committee reaffirmed the decision made several years ago that the annual meeting should be held during the latter half of June. Some consideration was again given to the proposal that the society hold two meetings a year, but the committee does not deem it advisable at this time to enter into this extension of the work.

St. Lawrence Joint Engineering Board



Left to right: Brig.-Gen. C. H. Mitchell, O. O. Lefebvre, D. W. McLachlan, of Canada; Secretary Hoover, Brig.-Gen. Edgar Jadwin, Col. William Kelly and Col. Pillsbury, of the U. S.

N. J. Sanitary Association Holds Jubilee Meeting

Paper on Future Water Supply of Chief Interest at Session Held Dec. 5 and 6

An elaborate program-pamphlet containing the history of the organization and sketches and portraits of some of its officials was one of the features of the fiftieth annual meeting of the New Jersey Sanitary Association, Dec. 5-6. Another feature was an exhibit. The meeting place was Atlantic City instead of Lakewood, where most of the conventions have been held for many years past. The newly-elected president is Dr. Charles W. Crankshaw, of Newark. Dr. Edward Guion, Atlantic City, was continued as secretary.

The paper of chief interest to engineers was "Where Will the Water Supply Come from Twenty Years from Today," by H. T. Critchlow, hydraulic engineer, New Jersey Department of Conservation and Development. Mr. Critchlow showed how closely water consumption is pressing upon safe yields of the water-works in the North Jersey metropolitan district and outlined the Hazen plan of 1922 for an immense storage reservoir (Long Hill, at Millington, N. J.) and a series of tunnels and reservoirs extending westward to be built progressively, with a final pumping draft on the Delaware River. In discussing this paper, Morris Sherrerd, consulting engineer, North Jersey District Water Supply Commission, stated that in place of the Long Hill reservoir the commission just named is studying the Chimney Rock site, above Bound Brook, which is considered more practicable since the initial outlay for this plan would be only about half of the $34,000,000 estimated as the initial cost of the Long Hill project.

In a paper on "Sanitation for the Camper and Hiker," James E. Brooks, consulting engineer, Glen Ridge, outlined in clear and simple language the elements of safe water supply and waste disposal for those indicated by the title of his paper.

Court Decisions

The recent New Jersey court decisions which have been a serious blow to zoning in the 66 municipalities which have adopted zoning in that state were touched upon in an address dealing with zoning and health, by Edward L. Katzenbach, attorney-general of New Jersey. Although showing himself in full sympathy with zoning, the speaker indicated that the court decisions mentioned hit zoning hard, although the decision of the Court of Errors and Appeals lightens the blow somewhat. In discussion, M. N. Baker, associate editor, *Engineering News-Record*, called attention to the fact that the decisions of the highest courts in several other states, notably a quite recent one in Massachusetts, were as sweepingly in favor of zoning as promoting the public welfare as are the New Jersey decisions against it.

Random Lines

Score One For the Rewrite Man

The press bureau of the Bureau of Standards a week or so ago issued the following bulletin:

> Added stresses in the steel reinforcement of a concrete stadium due to the vigorous enthusiasm of the crowd were measured during a recent game by means of the carbon resistance strain gages developed by the Bureau of Standards, Department of Commerce. By using these gages it was possible to record automatically the variations in the loading of the steel when the crowd all rose in a body or stamped in time to the band.
>
> Such mass movement, it has long been known, may increase the live-load on the structure far beyond that caused by the people when sitting or standing still or moving at random, but until recently it has not been possible to obtain an accurate record of such sudden changes of stress. In this particular test the live-load when the crowd was still was found to increase the stress in the steel by about 1,000 lb. per square inch, whereas 4,000 lb. would have been considered safe. Under the worst conditions occurring during the course of the game the movements of the crowd sometimes gave an additional 300 lb. per square inch.
>
> It is pointed out, however, that the worst conditions from the point of view of safety arise when the crowd, in stamping rythmically, happens to strike the natural vibration period of the structure. It has been reported that under these conditions the stress has exceeded the static live-load by as much as 150 per cent.

The rewrite man in the Washington office of the press association didn't like such technicalities so he dressed it up for popular consumption. The result:

> Washington, Nov. 30.—Spectators watching athletic contests from seats in modern stadiums need have no apprehensions that the structures will collapse when the crowd, in its eagerness to watch some close play, rises suddenly to its feet, or engages in concerted stamping to "rattle" an opposing pitcher. Tests just made by the Bureau of Standards have disclosed that the concrete steel reinforced stands have a textual strength of 4,000 lb. to the square inch and since the burden imposed by capacity crowds while quietly seated is only 1,000 lb. per square inch, what may be considered a safe margin of resistance is left to take care of the emotional moments.
>
> Under the worst conditions occurring during the course of a game the additional strain caused by the movement of the crowd was shown to increase sometimes about 300 lb. per square inch. The greatest strain from the view of safety, however, arises when the crowd stamps rhythmically. When such demonstrations happen to strike "the natural vibration period of the structure" the additional stress has been found to run as high as 150 per cent.

We can almost forgive the "textual" strength, and the juggling of the 4,000 lb. and 1,000 lb. originals into unintelligible relation—but those "emotional moments" have a double meaning that is almost censorable.

Central American Railway of 185 Miles Put Under Contract

A contract for the complete construction of the San Salvador-Texistepeque Division of the new line of railway which, extending from San Salvador, capitol of the republic of El Salvador, crosses into the republic of Guatemala and connects at Zacapa with the Guatemala Northern Division of the International Railway System, a total distance of 185 miles, has been entered into by the International Railways of Central America with R. W. Hebard & Co., Inc., of New York.

The Texistepeque-Zacapa Division has been under construction since early in the year by Messrs. Keilhauer & Rodezno. This line, together with that now to be built by R. W. Hebard & Co., the greater part of which embraces heavy mountainous work, will give International Railways of Central America an additional 250 miles of railway in Central America, and a new transcontinental line. The new construction will supply the necessary connecting link between the existing lines now in operation, extending from the port of La Union on the Bay of Fonseca (Pacific) to Salvador City, and the Guatemala Northern R.R. extending from Guatemala City to Puerto Barrios (Atlantic). There results therefore a line of railway originating in La Union which traversing the northern section of the Republic of El Salvador and eastern part of Republic of Guatemala, terminates at Puerto Barrios, a distance of some 500 miles.

Canal Centenary Celebrated

To mark the one-hundredth anniversary of the starting of construction for the first Welland canal between Lake Erie and Lake Ontario, Canadians, on Nov. 30, unveiled a cairn on the spot where George Keefer, president of the Welland Canal Co., in the presence of William Hamilton Merritt, promoter of the enterprise, on Nov. 30, 1824, turned the first sod for the original canal.

The first Welland canal was opened in 1829. It had 36 lift locks built of oak timber, 110 ft. long and 8 ft. deep. The second canal was built between 1842 and 1850 with 36 locks, 150 ft. long and 9 ft. deep, and the third canal the one still in use, was opened in 1887. It has 25 locks, with a depth of 14 ft. At the present time a fourth canal is under construction. In it the number of locks has been reduced to 7, with a length of 800 ft. and a depth of 30 ft.

Grade Separation to Be Ordered

After practically seven years of inactivity, the grade separation question along the west side of Manhattan Island is again brought to the front by a statement from the Transit Commission that it will issue an order directing the elimination of the New York Central grade crossings at the ferry approaches at 129th St. and at Dyckman St. in New York City. Such grade elimination was part of the plan for the reconstruction of the New York Central yards and tracks on the west side of Manhattan Island, rejected in 1917.

Actual construction cannot, in any case, be started until the state and city have appropriated their portion of the share of the cost, which is one-quarter each.

Engineering Societies

Calendar

Annual Meetings

NATIONAL DRAINAGE CONGRESS, Chicago, Ill.; Annual Convention, Chicago, Ill., Jan. 5-7, 1925.

AMERICAN ROAD BUILDERS ASSOCIATION, New York City; Annual Convention, Chicago, Ill., Jan. 5-9, 1925.

ASSOCIATED GENERAL CONTRACTORS OF AMERICA, Washington, D. C.; Annual Meeting, Washington, D. C., Jan. 12-14, 1925.

AMERICAN ENGINEERING COUNCIL, Washington; Annual Meeting, Washington, D. C., Jan. 16, 17, 1924.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Annual Meeting, New York City, Jan. 21-23.

ENGINEERING INSTITUTE OF CANADA, Montreal; Annual Meeting, Montreal, Jan. 27-29, 1925.

AMERICAN CONCRETE INSTITUTE, Detroit, Mich.; Annual Meeting, Chicago, Ill., Feb. 24-27, 1925.

The New England Water Works Association's three papers at its Dec. 9 meeting were on "Public Health Laws Relating to Water Supply," by Arthur D. Weston, assistant engineer, Massachusetts Department of Health; "The Law Relating to the Financing of Municipal Water-Works," by Theodore N. Waddell, director of accounts, Massachusetts Department of Corporation and Taxation; and "The Law Governing the Taking of Private Property," by Philip Nichols, attorney, Boston. Among future discussions are announced: For Jan. 13, "Corrosion," by Frank N. Speller, metallurgical engineer, Pittsburgh, and "Remedial Measures to Correct Corrosion in the Coolgardie Pipe Line in Australia," by Col. F. F. Longley; for Feb. 10, a symposium on Diesel engines, with the principal paper by C. B. Jahnke, chief engineer, Fairbanks-Morse Co.; for March 10, "The New Intake of the New Bedford Water Supply," by F. A. Barbour or S. H. Taylor.

Personal Notes

W. HORACE WILLIAMS, who, since its organization, has been president and general manager of Doullut & Williams Co., Inc., of New Orleans, La., which is being liquidated and dissolved, is to be president and general manager of the newly-formed company, W. Horace Williams Co., Inc., with offices at 816 Howard Ave., New Orleans. Associated with him in the new company will be the majority of the engineering, office and field organization of the former company. The new company will specialize in design and construction of docks, wharves, piers, breakwaters, dams, jetties, bridges, railways and industrial plants.

ERNEST SMITH, city engineer of Gadsden, Ala., after filling the office for more than ten years, resigned Dec. 3 to engage in private practice.

O. C. ROSS, head of the Ross Power Equipment Co., Indianapolis, has been appointed by the Indiana State Board of Health and approved by the mayor of Indianapolis as a member of the Indianapolis Sanitary Commission to succeed Jay A. Craven whose term expires Dec. 31. The commission has charge of the construction and operation of the Indianapolis sewage-works and garbage-works. It is composed of three members: one appointed as stated above, one being the city engineer in office from time to time and a third chosen by these two. Mr. Ross graduated from Purdue University in 1895, completed post-graduate work in 1900, and for six years thereafter practiced railway, sewerage and water-supply engineering. For the past ten years he has specialized in pumping machinery.

WINFIELD PARSONS, resident engineer, Bessemer, Ala., is the first city engineer of Bessemer, Ala., the position having recently been created by the city council. The statement in *Engineering News-Record*, Nov. 20, p. 849, incorrectly made it Birmingham, Ala. instead of Bessemer.

L. W. WALLACE, executive secretary of the American Engineering Council, is making a month's speaking tour of the South and West. Addressing local engineering societies in many cities, Mr. Wallace will interpret the aims of the council, stressing the movement to establish a National Department of Public Works. Mr. Wallace's itinerary includes: Memphis, Tenn., Dec. 11; Little Rock, Ark., Dec. 9; Pine Bluff, Ark., Dec. 9; Lawrence, Kan., Dec. 11 and 12; Topeka, Dec. 12; Manhattan, Kan., Dec. 13; Kansas City, Mo., Dec. 15. He will also visit Auburn, Birmingham and Tuscaloosa, Ala., and Nashville, Tenn.

GEORGE F. NICHOLSON, chief engineer and executive secretary of the Port of Seattle has resigned, effective Jan. 1, on which date he becomes chief harbor engineer, Port of Los Angeles. Mr. Nicholson has been with the Port of Seattle for 13 years and has been chief engineer for the past 8½ years. In recent years he has devoted considerable time to consulting work on harbor development and last year was retained by the city of Cork, Ireland, to make a comprehensive plan for harbor development in Queenstown and Cork. Mr. Nicholson was appointed to the new position at the same session of the Los Angeles harbor board at which Lansing H. Beach accepted the appointment as consulting harbor engineer, Port of Los Angeles.

IRA G. HEDRICK, W. D. SMITH, and LLOYD G. FROST announce the formation of a co-partnership to engage in the general practice of consulting engineering under the firm name of Hedrick, Smith & Frost. The office of the firm will be at 415-416 Abington Building, Portland, Ore.

MAJOR J. FRANKLIN BELL, Corps of Engineers, U. S. A., former district engineer of the U. S. Engineering Departments of New Orleans and Pittsburgh, and now engineer commissioner of the District of Columbia, was recently promoted to lieutenant-colonel. Colonel Bell was colonel of the 24th Engineers during the World War.

J. L. CAMPBELL, chief engineer of the El Paso & Southwestern Ry., has been appointed assistant to the chief engineer of the Southern Pacific Ry., with headquarters at San Francisco, Calif., the former road having been acquired as a part of the Southern Pacific System.

H. S. R. MCCURDY, formerly division engineer, Miami Conservancy District, Dayton, Ohio, and prior to that division engineer on the Catskill water supply for the city of New York, has joined the staff of Patrick McGovern, Inc., as construction engineer on the $14,000,000 contract which that firm holds for a portion of the Broad St. subway, Philadelphia.

Obituary

GEORGE A. NIXON, a principal examiner in the U. S. Patent Office at Washington, and at one time a railway construction engineer, died suddenly, Nov. 29, at his home in Chevy Chase, near Washington. Mr. Nixon was born in Covington, Kentucky, in 1857, and was educated at Chickering's Institute in Cincinnati, at Rensselaer Polytechnic Institute and Lehigh University. Upon leaving college he was employed in the engineering corps of the Chicago, Milwaukee & St. Paul Ry. on location, construction and topographic work. In his long service in the Patent Office he was examiner on applications for patents on hoisting apparatus, including elevators, cranes and derricks, and later, as a principal examiner and head of Division 13 had charge of applications in metal-working processes.

From the Manufacturer's Point of View

A Point of Contact Between Maker and User of Construction Equipment and Materials

Asymmetric Street Lighting Reduces Waste

New Refractors Direct Luminous Flux Where Needed on the Street Surface

By L. A. S. Woods
Manager, Street Lighting Section, Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa.

MODERN traffic conditions require a high intensity of illumination in street lighting, and since a high intensity means more and larger units, it is desirable that municipal officials when designing a street-lighting system should take advantage of the latest developments in light control and adopt the most efficient units.

The earlier developments in the control of light for street illumination involved the use of reflectors which conserved the upward light and added it to the downward light, increasing the illumination on the sidewalk and roadways adjacent to the unit. Later, prismatic refractors, totally or partially enclosing the light source, were developed to bend upward light toward the street surface. These devices, however, controlled the upward light only, and an equal amount of light was distributed on the horizontal plane in all directions around the units. This resulted in a condition with which we are familiar: a brightly lighted area adjacent to the units and a darker area between. This is known as "symmetrical distribution."

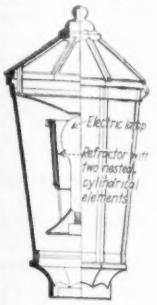
Ornamental Post Top

Symmetrical Distribution Wasteful

With the modern practice of mounting street-light units on ornamental posts installed along the curb it is evident that units which produce symmetrical distribution are wasteful and unsatisfactory in the results obtained. Ornamental posts are spaced at distances varying from 50 to 300 ft., according to local requirements. Under these conditions the distance the light must travel to illuminate the area between units is greater than the distance across the sidewalk or across the roadway. To produce an even illumination, with as much light between posts as is distributed on the street surface adjacent to the units, a light source producing *unsymmetrical* distribution is required.

The development of a device which would produce asymmetric distribution of illumination suitable for use in ornamental street-lighting units was announced last fall at Lake George, N. Y. when the equipment was demonstrated for the first time in public. Considerable interest was aroused, and it was generally conceded that the development of this device marked the greatest advance in the art of ornamental street lighting since the Mazda type C lamp was introduced.

This new device is known as the Bi-lux refractor and was briefly described in *Engineering News-Record* of Feb. 28, 1924, p. 384. As its name implies, it produces a graduated distribution of luminous flux on the street surface by means of refracting prisms. The refractor is designed to build up two wide paths of light converging in opposite directions up and down the street. This is accomplished by intercepting part of the light from the direction of the building, part from the direction across the roadway, and then bending it into the main luminous beams. The angle of maximum distribution of the two main beams is 22½ deg. from the curb line toward the roadway. The intensity is so graduated that an evenly distributed luminous flux is "sprayed" on the street surface.



Elements of New Refractor

The refractor consists of two cylindrical elements of crystal glass, nested one within the other and clamped together so as to form a single unit which is the shape of a frustum of a hollow cone. A series of horizontal prisms on the inner element bend the light flux downward in the direction of the street surface, while a series of vertical prisms on the other element bend the light rays into the two main 22½-deg. beams. The minimum distribution is in the direction of the sidewalk at right angles to the curb line, while a slightly increased intensity is directed across the road in the opposite direction. The resultant illumination is evenly distributed with glare reduced to a minimum.

Characteristic distribution curves of the Bi-lux refractor indicate that the light from a 4,000-lumen Mazda lamp is approximately equivalent to 2,000 cp. up and down the street, 425 cp. across the roadway and 225 cp. in the direction of the buildings.

The refractor controls practically all of the light from a lamp with the exception of a small portion of

Improved Lighting Installation, Sheridan Road, Chicago

Monthly Index Number for Locomotive Crane Sales

A substantial improvement in the locomotive crane business is indicated by the index number for November sales, based on reports made by the seven manufacturers constituting the Locomotive Crane Manufacturers Association. Last month sales of locomotive cranes amounted to 40 per cent of the normal producing capacity of the manufacturing plants reporting; this figure compares with an index number of 28.5 per cent in October and 29 per cent in September.

INDEX OF LOCOMOTIVE CRANE SALES

Month, 1924	Per Cent of Normal Capacity
September	29.0
October	28.5
November	**40.0**

Foregoing figures based on returns received from following manufacturers:

Brown Hoisting Mchy. Co.	Link Belt Co.
Browning Co.	McMyler-Interstate Co.
Industrial Works	Ohio Loc. Crane Co.
	Orton & Steinbrenner

the upward illumination. This upward light, which is negligible compared with the total output of the lamp, may be redirected, if desired, by means of a specially designed reflector, or it may be utilized for illuminating the building fronts by equipping the lighting unit with a glass canopy. This is desirable in downtown streets to bring out the details of the architecture of important buildings.

Another development in asymmetric units for ornamental street lighting has been made with octagonal lanterns equipped with refracting panels designed to produce results similar to those obtained with the Bi-lux refractor. In this case three of the panels toward the building side have the characteristics of reflectors, permitting a small amount of light to pass through, while the others are refracting panels which bend the light flux up and down the street.

AN INSTALLATION IN CHICAGO

The first ornamental street-lighting installation embodying this new principle of asymmetric distribution has been completed on Sheridan Road, Chicago, under the direction of the Commissioners of the North Shore Park District. Owing to its location between the city and the prosperous North Shore towns Sheridan Road, besides having considerable local traffic, is the main artery of travel north and south. The dense automobile traffic necessitated a high intensity of illumination, and after a careful study of the different types of modern street-lighting units the commissioners decided to install the new asymmetric system.

Since this part of Sheridan Road is largely residential, the canopies of the lights were equipped with upper reflectors to re-direct downward the upward component of light, which otherwise is utilized for illuminating the building fronts. The units are mounted on 14 ft. 6-in. (height to light center) hollow-spun concrete posts. The posts, numbering 154, are spaced 120 ft. apart on both sides of the street opposite one another. The width of the paved roadway is 54 ft. and this installation runs for about 1¾ miles. The lamps are 6,000-lumen, 20-amp. Mazda C operated from 24-kva. constant-current regulating transformers installed in a substation adjacent to the installation.

The accompanying night view of the new installation indicates the even distribution of illumination over the entire surface of the street and sidewalk and also shows how the illumination in the direction of the sidewalk decreases when it reaches the front lawns.

Thirty-nine cities have adopted the asymmetric system of street lighting since the completion of the Sheridan Road installation last December. The results obtained fully justify the enterprise of the municipalities in adopting the latest practice in ornamental street lighting.

OHIO VALLEY ROCK ASPHALT CO., S. O. LeSueur, president, manufacturing "Bituroc," a Kentucky rock asphalt product for road and street paving and flooring, has moved its general offices from Louisville, Ky., to 910 Schmidt Building, Cincinnati, Ohio.

Largest Wood Stave Pipe Has Diameter of 16 Ft.

A contract for 1,300 ft. of what is claimed to be the largest wood stave pipe line ever built, 16 ft. in inside diameter, has just been awarded to the Continental Pipe Manufacturing Co., Seattle, Wash., by the California-Oregon Power Co., Medford, Ore. This pipe will form the connecting link between two rock tunnels near Thrall, Calif., and will be built of continuous creosoted fir staves serving as a power line under a 60-ft. head, carrying water from the Klamath River. The next largest pipe line, according to the manufacturer, is 14 ft. in diameter erected by the company nine years ago.

Freight Rate Case Involves Steel Pipe Classification

A case involving the proper classification of riveted steel pipe for the determination of railway freight rates —Duluth Boiler Works vs. Atchison, Topeka & Santa Fe Ry.—has been decided by the Interstate Commerce Commission in favor of the railway company. The pipe was designed for use under high pressure as a penstock for a hydro-electric development and was shipped from Duluth to Howells, Calif., in 1920. The point at issue was whether the pipe, 42 in. in diameter, of metal 1 in. thick and in sections 30 ft. long, averaging about 57,000 lb. per carload, fell under the tariff category of "pipe, riveted, minimum 30,000 lb.," or under that of "conduits (not insulated or flexible) iron, coated or enameled." For the latter classification the freight rates per 100 lb. were about 40c. less than for the former, which the railway actually charged. The total shipment of pipe included 34 carloads.

The pipe manufacturer contended that although his shipments were described in bills of lading as steel riveted "pipe," they were in fact steel "conduits." On the other hand, the railway maintained that in ordinary practice the term "conduit" is used to denote a soft, seamless steel article used for conducting electric wires and that the framers of the tariff did not intend to include under the "conduit" classification anything but electrical conduits.

In dismissing the complaint against the railway company the Interstate Commerce Commission ruled that "the shipment consisted of riveted steel pipe and we find that the rates assessed were applicable."

Southern Exposition Postponed

William G. Sirrine, president of the Southern Exposition, has announced the postponement from Jan. 19-31 to May 11-23 of the Southern Exposition, to be held in the Grand Central Palace, New York City. The postponement from January to May was made necessary by reason of the fact that a number of states could not complete in time their arrangements to make displays. It was the original purpose, and still is, that a majority of the Southern states should participate, thus truly representing the growth and development of the entire South in the past few decades.

Business Notes

NORDBERG MANUFACTURING CO., Milwaukee, builder of steam, gas and oil engines, pumps and compressors, announces its entry into the manufacture of underground shoveling machines. The company is now licensed to build and sell the Armstrong Model 12 "Shuveloder" succeeding to the business of the Lake Superior Loader Co. of Duluth. The Nordberg company has organized a special department to handle the new product.

MCMYLER-INTERSTATE CO., Bedford, Ohio, has acquired from Fogarty Excavating Appliances, Inc., Rochester, N. Y., the right to manufacture and sell the Fogarty bucket.

STOCKLAND ROAD MACHINERY CO., Minneapolis, has completed arrangements with the Corry Bridge & Supply Co., Corry, Pa., to handle its line of road-building machinery in Eastern Pennsylvania. For Western Pennsylvania the company has appointed as its distributor the Ward Equipment Co., 331 Fourth Ave., Pittsburgh.

JOSEPH T. RYERSON & SON, INC., Chicago, have purchased an interest in the Reed-Smith Co., Milwaukee, an independent steel warehousing firm serving that section of the country. Under the new plan the officers of the Reed-Smith Co. are: D. M. Ryerson, president; George W. Smith, vice-president and general manager; E. L. Hartig, treasurer; Carl Gallauer, secretary. Joseph T. Ryerson & Son will maintain practically daily car service from Chicago for delivery of special orders. The company's line includes steel bars, shapes, plates, sheets, tubes, rivets, bolts and nuts.

FAIRBANKS, MORSE & CO., Beloit, Wis., held a sales convention and inspection trip during the week of Dec. 1, attended by 28 branch managers in addition to factory and general office executives. After conferences at the company's executive offices in Chicago, a party of 52 proceeded by special car to the electrical machinery plant at Indianapolis, the pump factory at Three Rivers, Mich., and the engine plant at Beloit, Wis. W. S. Hovey, vice-president and general manager, stated that the outlook for 1925 is better than it was at the beginning of 1924, due largely to improved agricultural conditions. Recent improvements in the company's scales, according to A. E. Ashcraft, included plate fulcrums instead of knife edges for track scales, machined pivots and stands and new dial and beam types. In the company's electric products, according to A. W. Thompson, one of the major improvements has been the production of ball bearing motors; 75 per cent of the motors now produced are equipped with ball bearings. At the company's Three Rivers plant W. L. Woodward called attention to a new high speed ball-bearing pump and motor unit under

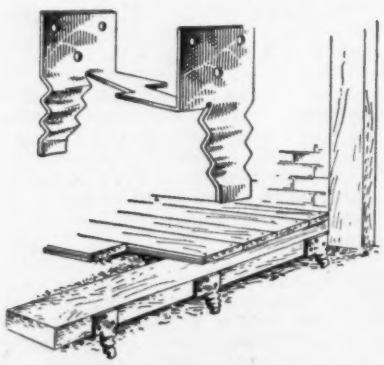
test; it is rated at 325 gal. per minute against a 234-ft. head, developing an efficiency of 74.5 per cent. At the engine plant in Beloit C. B. Jahnke, chief engineer, discussed the new Fairbanks Morse vertical Diesel engine for marine and stationary service in ratings from 36 to 300 hp. These engines start without the aid of auxiliary ignition devices. During the past twelve years the company has installed more than 700,000 hp. in oil engines, according to J. D. Harper, general manager of oil engine sales.

ALBERT OLIVER, president of Albert Oliver & Son, New York, for many years associated with the manufacture and sale of fireproof building products and inventor of the Oliver mortar gun, a new machine in the building industry, died suddenly in New York, Dec. 8 as the result of a heart attack. He was apparently in perfect health up to the moment of his collapse and had spent the day at his offices in a demonstration of his new mechanical mortar-spreading device to representatives of the city building department. Mr. Oliver was just 60 years old; he was born in Canada. In the building industry he became well known some years ago for his work in developing the use of Clinton wire-cloth reinforcement.

Equipment and Materials

New Clip for Floor Sleepers and Wall Furring

For attaching wood sleepers to concrete floors or furring strips to walls, the Dayton Sure Grip & Shore Co., 400 Realty Bldg., Dayton, Ohio, has developed a new clip or grip of Armco rust-resisting metal. As shown in the accompanying sketch, the device is firmly anchored in concrete or in the



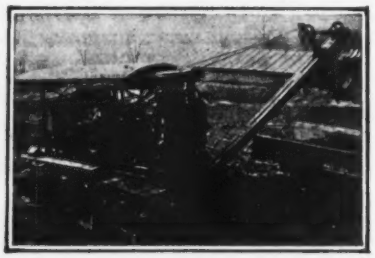
joints of brick walls, by a pair of corrugated legs; a pair of tabs with nail holes holds the wood strips. If desired, these tabs may be bent down flat until ready for use, a feature which allows them to be tacked to the insides of concrete forms or set in floor concrete without offering projecting obstructions.

The new grip is the invention of Carl Kinninger, construction superintendent of the Danis-Hunt Construction Co. of Dayton.

Gas Engine Drive for Excavator

A gasoline engine drive has recently been incorporated by the Keystone Driller Co., Beaver Falls, Pa., in its skimmer scoop and pull stroke ditcher bucket excavator formerly operated by steam. On the new unit another innovation is the mounting of the front end of the machine on crawler traction.

The excavator weighs 17 tons and is operated by a four-cylinder 57-hp.



Climax gasoline engine. The skimmer scoop attachment with a ¾-yd. bucket gives a 14-ft. horizontal crowding range, adapted particularly to shallow repaving jobs and tearing up old macadam or blocks. With the pull stroke ditcher attachment for trench or cellar excavation the working range is a depth of 20 ft. and a width of from 14 to 54 in., depending on the size of the bucket, which is commonly 24 to 30 in. wide.

With the crawler mounting on the front end of the machine the traction speeds are 1 and 2¾ miles per hour. The overall dimensions of the excavator are 24 ft. 7 in. in length (excluding boom), 11 ft. 7 in. in height and 10 ft. in width. The wheel base is 15 ft. 8 in.

Publications from the Construction Industry

Acid-Proof Pipe—DURIRON CO., Dayton, Ohio, has issued a 24-p. illustrated pamphlet on pipe for drainage and ventilation purposes. The outstanding feature of the material, which is a cast alloy of iron, is its resistance to acid-bearing liquids or gases, without requiring an inside protective coating. This pipe has been used for drain pipe in schools and laboratories, hospitals, and commercial and industrial buildings. Several pages are devoted to tables of sizes and weights of the pipe and fittings. The material, Duriron, is applied also to the construction of acid-proof exhaust fans for ventilation.

Snow Loaders—BARBER-GREENE CO., Aurora, Ill., shows a number of applications of its crawler type belt-conveyor snow loader in a 24-p. illustrated pamphlet entitled "Snow Insurance." Under good conditions, the manufacturer states, the rated capacity of the machine is 5 cu.yd. per minute. Included in the text is a snow fall table showing the precipitation in 12 cities from 1912 to 1923, inclusive.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

Total 1924 Construction Compared With Two Preceding Years

The following tabulation shows the total money value of all large engineering construction jobs awarded during the three years, 1922-3 and 4. The figures are for the entire country according to the various classifications of work. The last three weeks of the current month, however, are estimated.

In this table as published in *Engineering News-Record*, issue of Dec. 4, 1924, p. 932, the following line was omitted: (000 omitted on above figures).

These contracts reach the following minimums: Water-works and excavations, $15,000; other public works, $25,000; industrial construction, $40,000; and commercial buildings, $150,000.

This Year Ahead of Last in Number and Total Value of Contracts

The Construction News Section of *Engineering News-Record* has reported 8,900 large contracts awarded in the first eleven months of 1924. This is exactly the figure for the whole of 1923. The value of the average contract is $218,000, against $225,000 last year. The total is $1,945,000,000, compared with $1,876,000,000 for the first eleven months of 1923.

These contracts are of the following costs and greater: Water-works and excavation and drainage, $15,000; other public work, $25,000; industrial buildings, $40,000; commercial buildings, $150,000. The eleven month's total for

(*Continued on p. 978*)

Construction contracts of the size stated in the foregoing paragraph, as reported to *Engineering News-Record*, totaled as follows in the last three years:

	Waterworks	Sewers	Bridges	Excav.	Sts. & Rds.	Buildings: Industrial	Buildings: Commercial	Federal Gov't.
	(000)	(000)	(000)	(000)	(000)	(000)	(000)	(000)
1922	$36,220	$43,584	$43,477	$19,551	$334,694	$198,141	$750,762	$43,552
1923	62,518	66,769	66,778	51,991	361,837	281,611	813,392	47,940
1924	61,717	73,074	67,795	25,941	425,257	189,192	949,155	40,028

Taking 1923 construction as 100 in each class, the value for 1922 and 1924 would be as follows:

1922	58	66	65	39	93	70	93	92
1923	100	100	100	100	100	100	100	100
1924	99	109	102	50	117	67	117	83

Improvement in Demand for Construction Materials Being Met by Increased Output

Record Cement Shipments—Lumber Orders 20 per Cent Above Year Ago—Brick Plentiful at Yards—Steel Active

Steel—The total output of steel ingots for the entire country as calculated by the American Iron and Steel Institute, reached 3,107,226 tons during November. The October output was 3,111,452 tons while that of November, 1923 aggregated 3,134,321 tons. The drop in production during November was purely seasonal and amounted to less than one per cent, compared with the month preceding. Mill operations during the past week were at about 75 per cent of capacity, against 40 per cent in mid-summer. Following are the monthly totals, all companies, for eleven months, this year and last:

	1924 Tons	1923 Tons
Jan.	3,633,639	3,841,095
Feb.	3,809,185	3,471,843
March	4,187,942	4,066,680
April	3,333,535	3,963,736
May	2,628,261	4,216,355
June	2,056,466	3,767,256
July	1,869,416	3,531,458
Aug.	2,541,501	3,695,788
Sept.	2,814,996	3,356,776
Oct.	3,111,452	3,577,091
Nov.	3,107,226	3,134,321
Eleven months ..	33,093,619	40,622,399

Lumber—Demand is at the present time, greater than the output. Not since mid-summer has this been true of the lumber situation. Unfilled orders on books of the National Lumber Manufacturers' Association for the four weeks of November were nearly 20 per cent above actual production. While production and shipments for the entire country during the week of Dec. 4, were slightly below those of the preceding week, orders (new business) help up unusually well and were more than 20 per cent above last year for the same period.

The following table compares the national lumber movement for the three weeks indicated:

	Week of Dec. 4 Ft. B.M.	Corresponding Week in 1923 Ft. B.M.	Preceding Week in 1924 Ft. B.M.
Mills	358	377	382
Production	199,371,916	226,625,345	220,098,639
Shipments	218,665,057	210,111,233	237,637,007
New business	267,964,994	220,533,493	279,469,417

The following figures compare the lumber movement for the first forty-eight weeks of 1924 with the same period of 1923:

	Week of Dec. 4 Ft. B.M.	Corresponding Week in 1923 Ft. B.M.	Preceding Week in 1924 Ft. B.M.
1924	11,227,186,187	11,141,451,292	10,964,279,385
1923	11,872,011,379	11,758,585,105	11,174,851,839
1924 decrease	644,825,192	617,133,813	210,572,254

Cement—The gradual decrease in reserve stocks at mills throughout the country, since March, 1924 is purely seasonal and does not necessarily indicate scarcity. Production and shipments, however, are on the increase. Imports and exports of portland cement are both on the decline. While October shipments reached a new high level, reserve mill stocks were 33 per cent greater than the amount on hand in October, 1923, according to the Geological Survey. The following table shows latest available figures on the cement situation:

	Production 1923 Thousand Bbl.	Production 1924 Thousand Bbl.	Shipments 1923 Thousand Bbl.	Shipments 1924 Thousand Bbl.
First quarter	26,080	27,746	22,044	20,138
Second quarter	36,651	39,041	40,518	42,358
July	12,620	14,029	13,712	16,614
August	12,967	15,128	14,971	16,855
Sept	13,109	14,519	13,698	16,827
Oct.	13,350	14,820	14,285	17,081
Total 10 mo.	114,777	125,283	119,228	129,873

The following table shows mill stocks on hand at the end of each month:

	1923 Barrels	1924 Barrels
July	8,081,000	12,319,000
Aug.	6,080,000	10,666,000
Sept.	5,533,000	8,404,000
Oct.	4,612,000	6,143,000

Brick—The supply of burned brick at yards throughout the country has been increasing steadily since August of this year. At the same time, however, the reserves of unburned brick have been gradually diminishing. Shipments from yards have been on the increase since September. This is due to the necessity of stocking up dealers' reserves before freezing weather blocks water transportation in the Northern districts. The present reduction in demand is seasonal. The following table shows the situation as of Nov. 1, 1924:

1923	Burned Brick on Hand M.	Unburned Brick on Hand M.	Brick Moved from Yards During Month M.	Orders on Books M.
Nov. 1	306,922	129,310	.....	29?,177
1924				
June 1	223,458	70,802	163,298	394,156
July 1	258,474	72,725	158,753	366,098
Aug. 1	231,182	86,722	149,622	314,588
Sept. 1	261,800	68,138	120,777	256,017
Oct. 1	272,172	61,150	111,846	226,529
Nov. 1	312,061	44,543	135,806	186,977

Large Projects in Proposal Stage Show Confidence in 1925

That the unprecedented construction boom, started in 1922 and continued with increasing vigor throughout 1923 and the current year, is in a fair way to penetrate 1925 without loss of momentum, is suggested in the following list of large projects:

Hydro-electric project, Los Angeles, Calif., bonds voted, $25,000,000.
University group, Chicago, Ill., preparing sketches, $17,500,000.
Office building, New York, N. Y., preparing plans, $12,000,000.
Sewer system, Omaha, Neb., plans bond election, $5,000,000.
Waterworks, Cotulla, Tex., bond election Dec. 15, $5,000,000.
R.R. yards and depot, New York Central R.R., preparing plans, $5,000,000.
Hotel, Chicago, Ill., preparing plans, $5,000,000.
Office building, Chicago, Ill., preparing plans, $3,000,000.
Library, Chicago, Ill., bond election soon, $3,000,000.
Hotel, St. Louis, Mo., preparing plans, $2,500,000.
Apartment, New York, N. Y., preparing plans, $2,000,000.
Hotel, Chicago, Ill., preparing sketches, $2,000,000.
Hotels, Chicago, Ill., preparing plans, $2,000,000.
Clubhouse, Ft. Worth, Tex., preparing plans, $1,250,000.
Apartment, Chicago, Ill., preparing plans, $1,500,000.
Hotel, Dallas, Tex., bids desired, $1,000,000.
Hotel, Miami, Fla., proposed, $1,000,000.
Cotton mill, San Marcos, Tex., preparing plans, $1,000,000.

This tabulation is a very brief arrangement of eighteen of the most important items in a single day's announcement of proposals, bonds voted, bids desired, etc., as published in the *Engineering News-Record Daily Service to Advertisers*, issue of Dec. 3, 1924.

While most of these projects are in the proposal stage and some may never develop into awarded contracts, the confident attitude of builders with regard to 1925 is indicated.

CONDITIONS OF MATERIALS STOCKS IN IMPORTANT CENTERS

Stocks on hand in approximate figures, example: (Common brick, Denver, 5,000,000); time required for delivery of carload lots to city job, example: (Hollow tile, Atlanta, deliveries take 4 to 5 days); and stocks on hand in general terms, example: (Sewer pipe, Philadelphia, over 100 cars; normal)

	San Francisco	Denver	Detroit	Minneapolis	Atlanta	Philadelphia	New York
Sewer pipe	Plenty, all sizes	Just about enough to meet current demand	Sufficient for present requirements	Ample	Del. take 4 to 5 days	Over 100 cars on sidings	Mill shortages of a month ago not apparent now
Cement	Sufficient for current demand	Stocks in good shape	Plenty in local and nearby mills	Sufficient	About 80 cars on sidings	Supply normal	Gradual but seasonal decrease in stocks
Lime	Fairly well supplied	Enough	Immediate del. from nearby kilns	Adequate	70 cars; enough	Enough	Dealers' stocks usually small
Common brick	Large reserves at yards	5,000,000; sufficient	Ample in local yards	Normal	Plentiful	Supply normal	About 114 barge loads; only 9% of these unsold probable scarcity
Hollow tile	Ample	Just sufficient to meet current demand	Normal supply in city yards	Plentiful	Del. take 4 to 5 days	Sufficient to supply small orders only	Dealers stocks usually small; prompt del. by rail and water
Lumber	Douglas fir plentiful	Stocks in good shape	Decreased somewhat compared with earlier part of year	75,000,000 ft.; normal	Plentiful	Yard stocks small	Stocks no smaller; shipments slower
Asphalt	Native product	Plentiful	.....	Ample	100 cars; ample	Reserves low	Refineries nearby
Structural steel	Scarcity in certain sizes at warehouses	Warehouses well supplied	.....	Readily obtainable on short order	3 to 4 cars; sufficient	Moderate warehouse stocks; mill del. prompt	Slight pressure on mills for deliveries

This Year Ahead of Last in Number and Value of Contracts

(*Concluded from* 976)

reports of all kinds—proposed, bids desired, bids received and contracts awarded—published in Construction News is 30,681. With December lettings estimated at $125,000,000, a grand total for the year will probably reach $2,070,000,000 as against $2,002,429,000 for 1923. Distribution by number is as follows:

	New England	Middle Atlantic	South	Middle West	West of Mississippi	Far West	Canada	Total
Water-works	26	117	45	137	172	47	31	575
Sewers	22	94	27	181	125	57	38	544
Bridges	26	42	69	63	148	54	19	421
Waste disposal	1	2	1	4	2	.....	.....	10
Dams	2	5	2	2	5	9	3	28
Railways	.....	2	7	5	11	11	18	54
Excavation, drainage and irrigation	9	16	27	10	45	24	10	141
Streets and roads	106	352	373	577	835	408	119	2,770
Industrial buildings	161	240	94	330	182	183	28	1,218
Commercial buildings	309	577	153	544	320	288	56	2,247
Federal government	19	66	108	39	39	47	.....	318
Unclassified	28	100	36	54	71	60	43	392
Equipment and material	4	44	5	33	68	16	12	182
Total	713	1,657	947	1,979	2,023	1,204	377	8,900

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of December 4, the next, on January 1.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb.	$3.34	$3.80	$4.15	$3.10	$3.35	$4.00	$3.00	$3.35	$3.50
Structural rivets, 100 lb.	3.75	4.35	4.75	+3.65	3.75	4.65	5.00	3.75	6.00
Reinforcing bars, ¾ in. up, 100 lb.	3.24	3.30	3.38	2.60@3.00	3.25	+3.97½	3.35	3.25	3.25
Steel pipe, black, 2½ to 6 in. lap, discount	44%	54.2%	43%	53%	55.45%	36%	44.7@55.5%	45%	37.83
Cast-iron pipe, 6 in. and over, ton	55.60@56.60	56.00	—54.20	—46.70@47.20	55.50	—60.00	55.00	65.00	65.00
Concreting Material:									
Cement without bags, bbl.	2.50@2.60	2.35	2.05	2.20	2.42	2.84	2.61	2.65	1.80
Gravel, ¾ in., cu.yd.	2.00	1.90	2.38	2.75	1.65	1.90	—2.15	1.50	1.25
Sand, cu.yd.	1.00	1.40	2.00	2.75	1.25	1.00	1.50	1.50	1.25
Crushed stone, ¾ in., cu.yd.	1.85	2.00	2.83	2.75	1.75	2.50	2.15	3.00	2.25
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	55.00	34.00	57.20	55.00	+39.75	36.75	29.00	26.00	60.00
Lime, finishing, hydrated, ton	18.20	22.50	20.00	20.00	23.00	24.00	22.00	24.00	21.00
Lime, common, lump, per bbl.	2.50@3.00	1.45	1.85	1.50	1.35	2.70	1.60	2.80	10.50
Common brick, delivered, 1,000	18.00	10.50	12.10	12.00	15.00	12.00	15.50	—14.50	17.50
Hollow building tile, 4x12x12, per block	Not used	.1004	.0941	.089	.07	085	.....	.11	.12
Hollow partition tile 4x12x12, per block	.1162	.1004	.0941	.089	.....	.085	.108	.11	.10
Linseed oil, raw, 5 bbl. lots, gal.	1.11	—1.13	1.22	1.05	1.17	—1.25	+1.18	1.12	1.13
Common Labor:									
Common labor, union, hour	.75	.30	.....	.82½	.....	.50@.55	.55	.62½	.....
Common labor, non-union, hour	.....	.25	—.30@.60	.75	.50@.55	.35@.50	.50	—.50	.25@.30

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given; 45-5% means a discount of 45 and 5 per cent.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b.

Labor—Concrete laborers' rate, 93¾c.; building laborers, 75c.; excavating laborers, 62½c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; lump finishing lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.60 for Kelly Island and Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered in wooden bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, size 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir, common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Brick and hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on pine lumber. Sand stone, gravel and lump lime per ton. Stone, lime and tile are delivered; sand, gravel and cement on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 99.81). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 2½-in., $37.83.

Conditions Affecting the Market

The seven outstanding factors in the current market are: (1) Gain in construction during the first week of December over the week preceding; (2) increased iron output; (3) greater activity at steel mills; (4) unusually heavy lumber demand; (5) improvement in non-ferrous metals; (6) continued improvement in the textile industry; (7) heavier car loadings than at this time last year or the year before.

Price firmness is noted this week in reinforcing bars, structural rivets, fir timbers and common brick. Although brick dropped 50c. per M. in Seattle, the market has turned in the other direction so far as New York is concerned. It is feared that not enough brick can be shipped to the reserve docks at New York before navigation in the Hudson River is prevented by ice.

Weakness in linseed oil is still in evidence; the price dropped 4c. per gal. in Denver during the week.

Common labor rates seem to have been affected in certain parts of the Northwest and the Southwest. Return of men from the cotton fields has driven the wage rate for unskilled labor in Dallas to 30@60c. per hr., against the recent scale of 40@75c. Slight unemployment in Seattle has brought the non-union common laborers' rate to 50c., from 62½c. per hr. formerly.

The common labor rate for the nation, however, is higher now than in November.

While the latest reported freight loadings show a seasonal decline, miscellaneous materials and merchandise in less-than-carload-lot quantities are being shipped in greater volume than during the corresponding period in 1923 or 1922.

These loadings represent the small producers and dealers and when activity is present among them, a still greater volume of business is being transacted by the principal industries.

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